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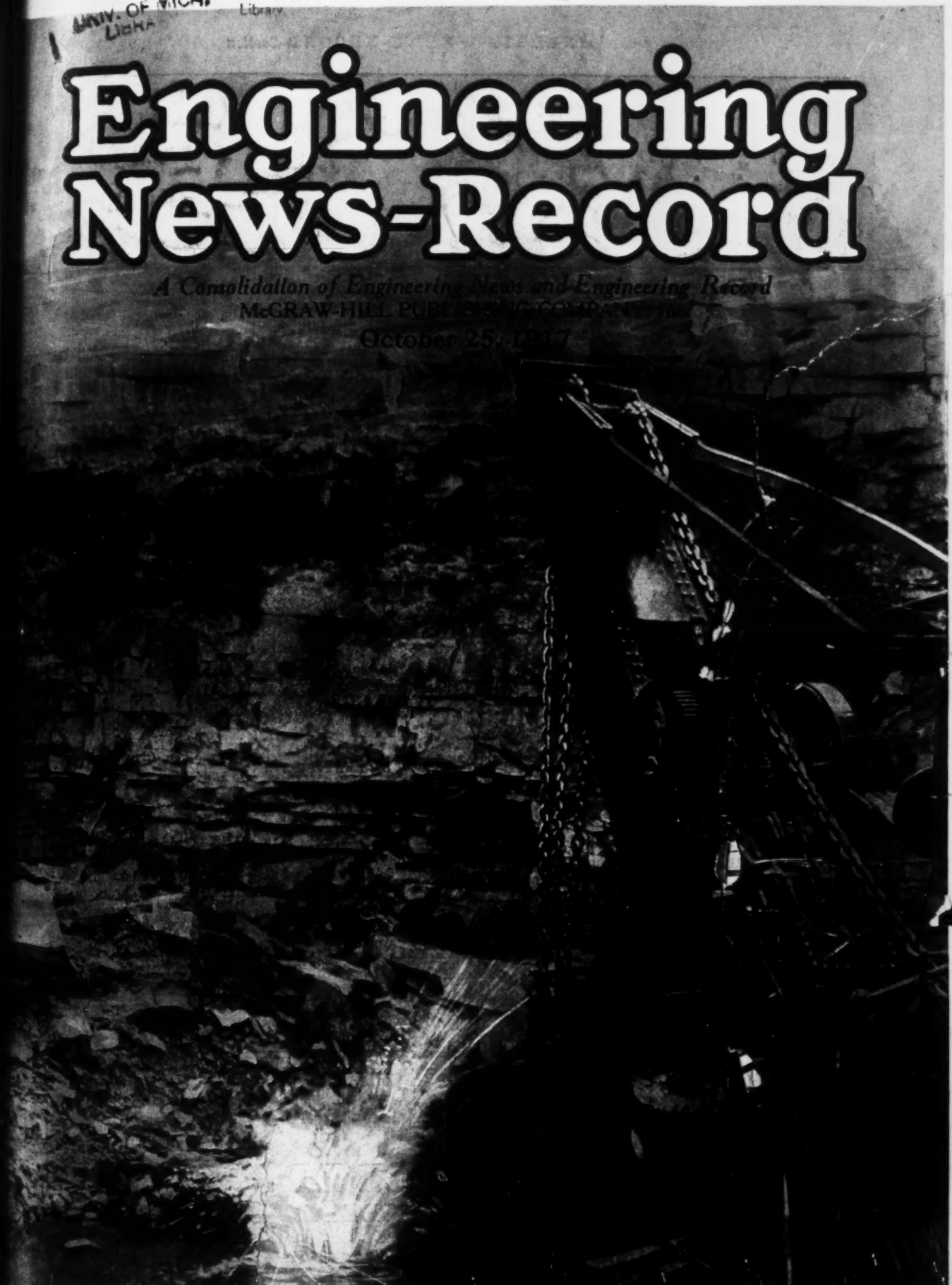
October 25, 1917



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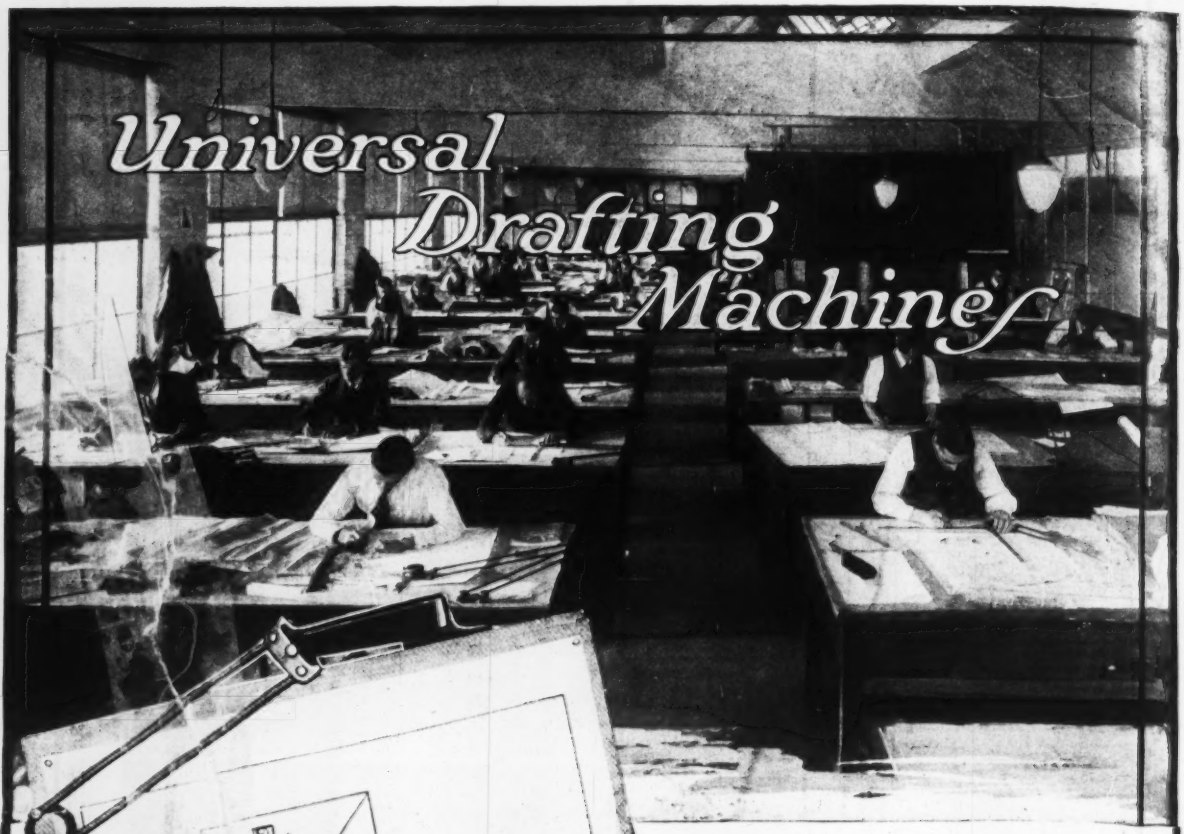

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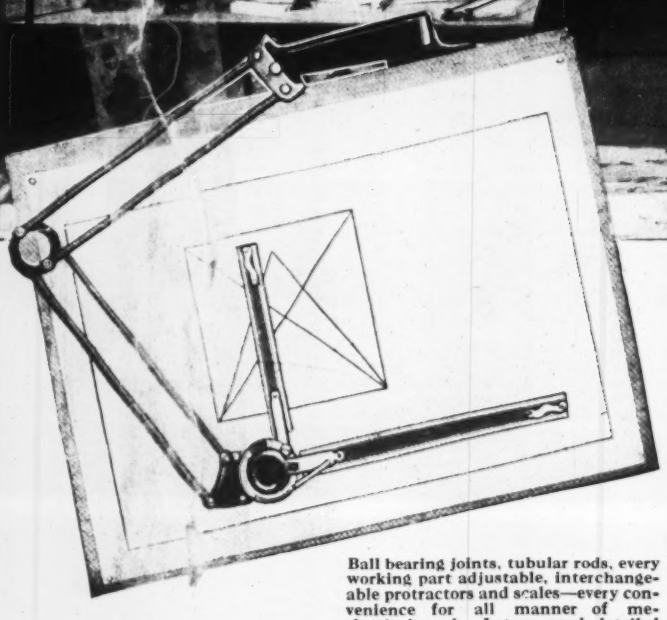

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Volume 79 NEW YORK, THURSDAY, OCTOBER 25, 1917 Number 17

A Significant Note on Reconstruction

LAST WEEK'S issue contained a personal note that was significant of what will be one of the post-bellum activities of engineers—the reconstruction of devastated areas. It related that a Canadian engineer had become associated with an English town-planning specialist in replanning Saloniki. We have long foreseen that such work was coming. Now it is here, and its activities have affected the profession even on this side of the Atlantic.

New Promise of Engineering Solidarity

INDICATIONS from many cities that local engineering societies are starting the season with increased activity give hope for continued progress in the direction of engineering unity. If large attendances and interested discussions at club meetings mean anything, it is that engineers feel the need of getting together; united, they can accomplish what their separate efforts would fail to achieve—a simple truth, but one which engineers, above all men, have ignored largely in the past. The stress of the times and the effective cooperation of engineers in patriotic endeavors to meet the nation's needs have been powerful factors in bringing them together in spirit. Today the greatest as well as the least perceive the need of standing shoulder to shoulder, a united profession—or, at least, they are beginning to perceive it. In this perception lies a splendid augury: The solidarity that has been lacking in the profession may come to be soon a reality.

Advertising the 23rd Engineers

WE ARE BECOMING accustomed to an unprecedented openhandedness in the support that individuals and business are giving to the Government. We are surprised agreeably by the new ways of doing this that manifest themselves daily. The banks and manufacturers are using their advertising space, not for solicitation for business for themselves, but for selling Liberty bonds. Many companies are lending their salesmen for the bond campaigns, while the Red Cross has received a degree of support second only to that tendered to the Liberty loans. The manufacturers of engineering supplies and contractors' equipment have taken places in the front of this patriotic activity. As evidence of what they are doing, we may cite this issue of *Engineering News-Record* and also the last one. Three weeks ago this journal appealed, in behalf of Colonel Johnston, for recruits for the 23rd Engineers, the road-building regiment. The response was most gratifying, but with a determination to do all that was possible, a representative of Colonel Johnston suggested to a number of manufacturers that they devote their advertising space to an appeal for recruits. As a consequence, the two issues carry about 15 pages of advertising regarding the highway regiment, donated by some 30 manufacturers. Unfortunately, when the history of this war is written it will be impossible to record the contributions of money and effort by individuals and corporations. Therefore, the patriotic manufacturers who are assisting, by the donation of their advertising space, in the recruiting of the 23rd Engineers must be content with the knowledge that they have done their share in the accomplishment of the great end.

War a Reason for Holding Not Postponing Convention

SOME of our national technical societies have given up their meetings this year on account of the war. Others have seized upon the war as a means of making their conventions of even greater value than usual. Notable among the latter was the meeting of the American Public Health Association held at Washington, Oct. 17 to 20. War problems had a large and useful place on the program, as may be seen from abstracts of some of the papers beginning on page 777 and in the report of the meeting on page 811. Naturally, the proceedings of the Sanitary Engineering Section receive most attention in our columns. This section has done much good work since it was organized a few years ago. Special commendation is due the committees mentioned on page 811, whose code for the sanitary control of waterways and definitions of sewerage and sewage disposal terms were adopted by the section at the Washington meeting.

A Visit to Washington

NOT UNTIL there is universal recognition of the fact that today the first business of the nation is war will we be fully armed for the conflict. Many of us, having given our sons, or having changed our normal occupations or strained our resources to lend money to the Government, know that we must make sacrifices. But even among us there is not full realization of the magnitude of the conflict or of the extent of our preparation. A visit to Washington gives one a true perspec-

tive. A new spirit would animate our national life if every citizen could go to the capital and see what the war and navy departments and the committees of the Council of National Defense are doing.

Our people have not an adequate conception of what is entailed by our war preparations, principally because the activities are so many and so varied that the press of the country has been unable to describe them adequately. The newspapers have tried to interpret Washington's activities. There was some publicity regarding the cantonment construction, much on the liberty motor, the liberty truck and the Government's aëroplane program. These, being details of the great scheme and being expressed in figures within reach of the popular imagination, have made some impression on the people. But when the press reports the passage of a $7,000,000,000 appropriation bill or announces that the war, in its first year, will cost $19,000,000,000, the statements carry no conviction. The figures are too stupendous. Our experience furnishes no yardstick by which to gage them. We need details.

Certain classes have a clearer comprehension than others of what is going on in Washington. The manufacturers whose normal procedure has been completely upset realize the situation best. Second to them, we believe, are the engineers of the country. They have been called on in such large numbers to help the Government that even those who are not taken into service have hosts of friends on duty at Washington or at the front. Not until one visits Washington, however, does one get an adequate idea of the extent to which engineering underlies the whole great military business. One gets some conception when he is told that while the Ordnance Department figured in the hundreds the cannon that it made in years of peace, it must now turn out 16,000 pieces, of various calibers, within 18 months. One division of the Corps of Engineers office has normally ordered $50,000 worth of supplies per annum. In July, August and September of this year its commitments were no less than $90,000,000. And these supplies have been bought by engineers, under engineering specifications. The marvelous story of the cantonment division of the Quartermaster's Department is probably the best known of the Government's war engineering activities, yet it is matched by the work of more than one other department. And when one is told at the end of two or three days of inquiry and study that the height of our engineering purchasing and other engineering activities will probably come on the day before the war stops, one goes away with the solid conviction that war is truly the nation's business at the present minute, and that war will continue to be its business until our men come back victorious.

One feels, too, after a visit to Washington that those in the capital have done a magnificent job, have accomplished wonders, and that the country at large both fails to understand what has been done and has been niggardly of praise.

As the war goes on, more and more of these interesting facts will become known, and our attitude as a people will change so that all right-thinking persons will be in a mood to make all needful sacrifices and will be content to get merely a bare living, if so much of sacrifice be required, until the war is won. Everyone cannot visit Washington in order to receive the inspiration of its activities. Therefore, Washington must be carried to the people by a persistent telling of the story of the war's activity.

More Toying with a Big Problem

READING New York's newspapers, even those that favored the scheme tentatively agreed upon by the Board of Estimate and the New York Central Railroad, one would be likely not to realize the futility, not to say absurdity, of the steps recently made toward a solution of the so-called West Side improvement problem in our first city. Apparently a joint committee of the Board of Estimate and the Public Service Commission has been giving the whole problem the most careful study, and has evolved a plan made public early this month, which eliminates practically all of the features objected to by various organizations in the 1916 plan. These organizations admitted this at the public hearing last week—a hearing where all seemed to be harmony. And already the great acumen of certain men in finding such simple remedies to the glaring defects of the 1916 plan is being cited as an additional reason for the election or reëlection of these men to important offices next month.

The New York Central, which many people think will be a party to whatever arrangement is finally made, did not send a representative to the hearing. Several days before the hearing Ira A. Place, vice-president and chief counsel of the railroad in this matter, announced his company's absolute rejection of the new plan. Some of the propositions, such as the one that the company pay rent for land it now claims as its own, and that the city be allowed to terminate the entire lease in twenty-five years, he characterizes as astounding. All of the changes suggested, states Mr. Place, were proposed by various interests as well as by the New York Central prior to the tentative agreement of 1916, and were rejected as either unwise or impracticable.

Although by the law passed last spring this joint committee must step down and drop the problem if a solution is not found by Dec. 1, Mr. Place points out that the committee's proposals are not accompanied by any new maps, estimates or figures of any sort, and he does not see how they could be given the 30 days' publicity before Dec. 1 required by law. It occurs to this journal that there may be very serious engineering flaws in this new plan, some of whose new features are mentioned in the news section of this issue. But important as these questions may be, they are insignificant compared with the flat refusal of the New York Central to do business on the basis of the general terms of the proposals of the joint committee.

For six years the Board of Estimate had been thrashing out with the New York Central the various points involved, and had, it appears, made a good bargain. In order to get the facilities it sorely needed the company was willing to pay for practically the entire improvement, and even do much park improvement work for the city. On the other hand, the company was confident that the courts had established its title to its present right-of-way, and the Board of Estimate saw the folly of disregarding that title. Last spring, after these six years, when board and railroad had virtually agreed, the Legislature passed and the Governor signed an

ill-considered law which virtually took the matter out of the hands of the board. Until Dec. 1 the board and the Public Service Commission were to work together for a solution, but in the event of failure the entire problem was to be turned over to the commission.

Engineering News-Record was convinced at the time of passage that this law destroyed the chance of an early settlement of the matter. The developments of the last three weeks bear out that conviction. Mayor Mitchel showed a fine scorn for the possibility of a better settlement than the Board of Estimate had advocated by giving all three places on the joint committee to opponents of the board's scheme. They were given a free rein, and apparently they have not discovered yet that they are not headed anywhere. In five weeks more, unless they effect a miracle, they too will be eliminated from the negotiations, and the Public Service Commission will be in sole command of the situation.

In six years possibly the commission, having studied the matter from all angles, as the Board of Estimate did, having debated each point with the railroad, will make the headway the board had made in 1916. Perhaps following a course more in accord with its present views, it will force a different solution. Perhaps city and state will pay for their share of the improvement according to the terms of the state grade-crossing law—25 per cent. each. Possibly legislation yet to come will give the city better terms than that. But *Engineering News-Record* is sure that no early solution will come except substantially along the lines of the 1916 plan, and as sure that no solution will ever come that is enough better than the 1916 plan to compensate for the delay.

The Engineer's Interest in Foreign Trade

"IT IS of the highest importance to familiarize our people with the fact that . . . . the next important task for this country will be that of financing the rehabilitation of industry throughout the world." In the foregoing sentence, John Clausen, vice-president of the Crocker National Bank of San Francisco, addressing the Southern Commercial Congress at New York City on Oct. 17, summarized a situation of great importance to the engineers of this country. It is becoming evident that this country will have, at the close of the present struggle, an unequalled opportunity for useful development, both because of its great financial resources and because of its possession of the labor, equipment and materials for economical production. It is equally certain that this country will miss its opportunity of rendering the greatest service to the rest of the world, thereby increasing its own strength and prosperity, unless these resources are organized in ways the very necessity for which the people of this country do not appear to realize yet.

The average man, especially the average engineer, must learn to appreciate the tremendous influence which foreign trade will have on domestic affairs after the close of the war. We shall reach the time of peace with a great accumulation of capital. Most of the important nations with which we trade will be in our debt. To discharge these debts, they will be obliged to send goods to us. To regain their position as creditor nations, they will be obliged to force production, restore and expand their foreign trade and reverse the unfavorable trade balances now standing against them. With these ends in view the business men of these countries are already organizing efficiently.

Unless this country can hold its own in the face of such competition, it will not expand as it should. Industrial development will not take place unless the manufactured products can be sold. If we cannot sell our products abroad and if they have to meet in domestic markets the competition of powerful combinations of foreign producers, a sufficient volume cannot be sold to guarantee the further development of our industries. In order to sell our products abroad, we must be able to finance the purchasers, and to invest in the development of the countries to which we sell, so that they may produce more and buy more.

To do this, there must be some systematic method of handling the foreign banking business of the country, while the investing public, which controls our great accumulation of capital, must be taught to absorb the securities of foreign enterprises. We have made as yet scarcely a beginning of these things. Even the Webb bill, which would permit merchants and manufacturers to combine for the extension of their foreign trade, passed the House of Representatives by a bare majority and has yet to be acted upon by the Senate. Although the Federal Reserve Act provides for the establishment in foreign countries of branches by member banks, and permits coöperative participation in the organization of banking interests beyond our borders, few institutions have taken advantage of it. One engineering firm estimates that development work which is ready to go forward in South America alone at the close of the war would require at least $500,000,000 worth of new construction, yet little has been done toward popularizing the securities of such enterprises with our investing public.

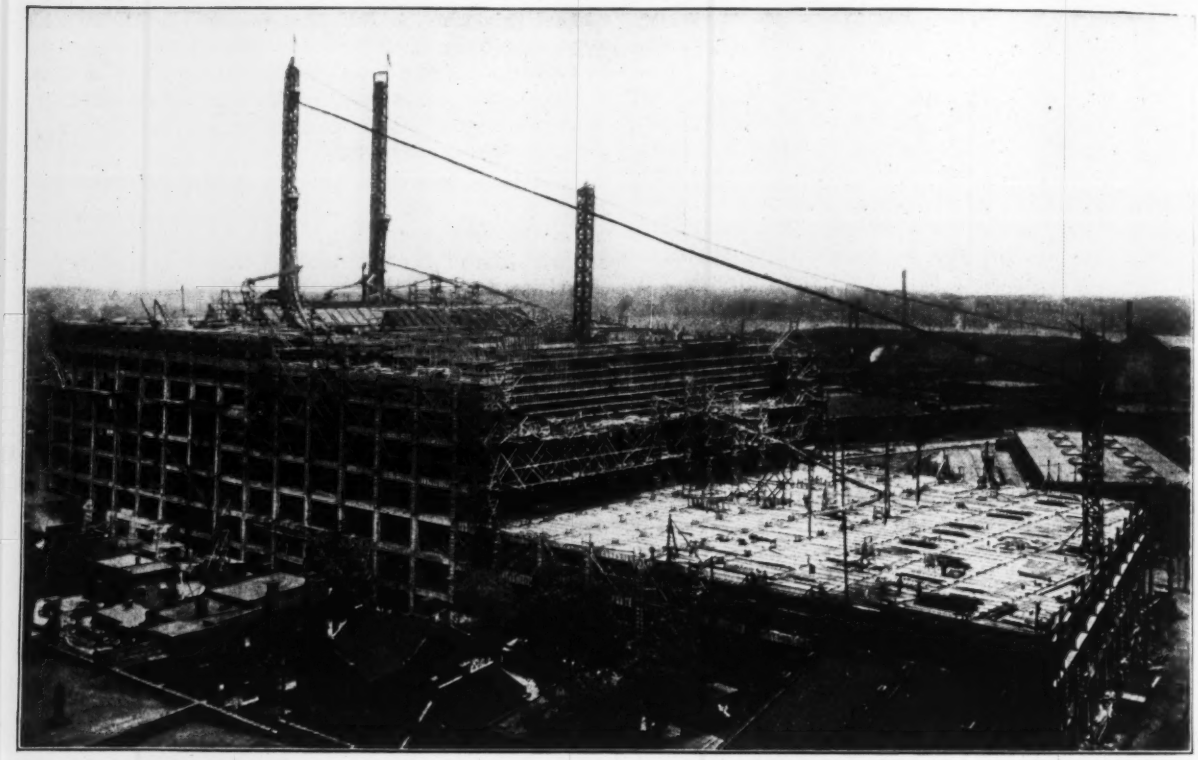
Mr. Clausen suggests, in addition to the passage of the Webb bill, the formation of a foreign credit institution of national scope, connected with our Federal reserve system, to do the work of the British corporation referred to; measures for awakening the business men of the country to the necessities and opportunities of the situation; and the education of the rising generation of business men in those subjects which have a bearing on the development of foreign trade.

When the public recognizes that our part in international commerce must be an important one, if we are to grow at all; when it is understood by our business men and bankers that we must have, to achieve this result, efficient methods of handling foreign credits; when investors realize that our capital must be devoted, to an increasing extent, to the development of other countries, if they are to prosper sufficiently to trade with us; and when we begin the systematic education of a good proportion of the rising business generation in the numerous new subjects which must be mastered for the successful development of foreign trade, there need be no further anxiety about our domestic progress. We have assumed an international rôle in commercial affairs. Unless we prepare to play it intelligently, we need not expect industrial and commercial development of a character to present new opportunities to our engineering and construction forces.

Largest Concrete Building Now Under Construction at St. Louis

Bevo Bottling and Shipping Plant Is Eight Stories High and Covers Three Acres—Simple Beam and Girder Design—Expansion Joints Divide Building Into Three Sections

By W. J. Knight
Contracting Engineer, St. Louis, Mo.



CONCRETE ON LARGEST CONCRETE BUILDING IS PLACED THROUGH CHUTES NEARLY 600 FT. LONG

THE NEW plant in which the Anheuser-Busch Brewing Association will bottle and ship its non-alcoholic beer, known as Bevo, will be the largest reinforced-concrete building ever built, so far as available records go. It occupies an entire block near the St. Louis, Mo., river front, 542 ft. 9 in. on one side, 601 ft. 10 in. on the opposite parallel side and 252 ft. in the other direction. There will be eight stories above grade, the upper three of which form two balconies, and there is a 26-ft. receiving and shipping story below grade. The total floor area for the seven stories and two balconies is 1,078,012 sq.ft., or 24.75 acres. The cubic contents of the building and of a subway leading to it is 21,335,000 cu.ft.

This is slightly smaller in acreage but larger in cubage than Buildings 19 and 20 of the Bush Terminal group in Brooklyn, N. Y., which has hitherto been considered the largest concrete building. However, the Bevo building is far ahead of the Bush unit in its material content, which will total 8600 tons of reinforcing steel and 75,000 cu.yd. of concrete.

The building is to be used for the bottling and shipping of the beverage, which is brewed in an adjoining building and pumped to large tanks on the upper floors. The complications of machinery and the presence of 13 loading tracks running into the basement were the governing features of design; the former having its effect on the loadings and hence on the layout and member design, the latter requiring a very high basement story and a long viaduct carrying the marginal street over the tracks entering the building.

Before the final system of design was adopted, an exhaustive study of the various floor systems in general use was made, for the purpose of ascertaining the most economical construction consistent with the arrangement of machinery units, established requirements, floor loads, etc. The fixed arrangement of machinery units and floor openings for conveyors, chutes, escalators, stairs, etc., proved to be the dominant features in controlling the nature of system finally employed throughout the construction. The sizes of machinery units determined the spacing of all columns, which are spaced uniformly with few exceptions, 25 ft. c. to c. north and south and 16 ft. 6 in. c. to c. east and west. The floor system consists of two intermediate beams 5 ft. 6 in. c. to c. in each panel, spanning 25 ft. and supported by girders between columns.

All floors, with the exception of the fifth and sixth and the upper balcony, are designed for a uniformly distributed live-load of 275 lb. per sq.ft. A portion of

the fifth floor is designed to support pasteurizers and tanks, the former weighing 125,000 lb. and the latter, 10 ft. 6 in. in diameter, weighing 75,000 lb. each. The load on a large portion of the sixth floor consists of a series of machines each weighing 130,000 lb. A large portion of the upper balcony is designed to support tanks averaging about 500 lb. per sq.ft. of floor.

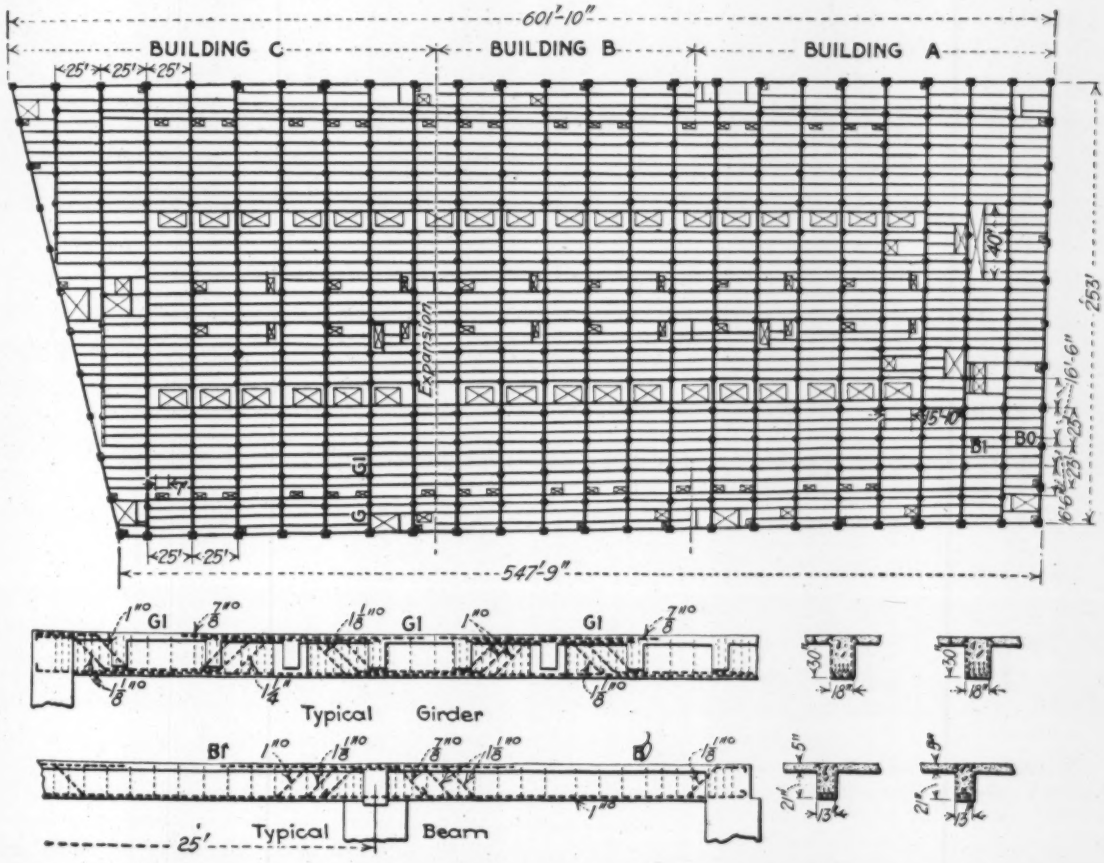
The typical interior beams, continuous at both ends and spaced 5 ft. 6 in. c. to c. with 25-ft. spans supporting a 5-in. slab and 275 lb. uniformly distributed live-load, are 13 in. wide by 26 in. deep. Reinforcement consists of two 1-in. rounds and two 1⅛-in. rounds, one-half the steel area being bent up at angles of 45° near the supports to provide for diagonal tension and negative moments. All diagonal tension in excess of 40 lb. per sq.in. is resisted by bars bent up at 45°. Stirrups consisting of ⅜-in. rounds bent in U-shape, spaced at intervals increasing toward the center, are employed primarily to assist in making the mass a more homogeneous unit, without accepting the generally adopted assumption that vertical U-stirrups serve as a medium of resistance to diagonal tension.

The typical continuous girders, spanning 16 ft. 6 in., are 18 in. wide by 30 in. deep and are reinforced with four 1-in. round straight and two 1-in. round and two ¾-in. round bent rods. The latter are bent up at points beginning at concentrated loads. The ⅜-in. stirrups are spaced 6 in. c. to c. at ends and 18 in. between concentrated loads. In this instance, as in the case of beams, the bent-up rods and additional rods at supports are employed to resist all diagonal tension.

The intensity of varying stresses in all members were established by moment diagrams according to method adopted by Prof. Emil Morsch, by first considering the member fully loaded with adjacent member unloaded and then with loading condition reversed. This method establishes accurately the points of maximum and minimum positive and negative moments throughout the length of the members, permitting a more accurate distribution of the steel.

In a building of this length the question of providing for expansion and contraction was given much study. The many contradictory opinions on this subject made it one of particular concern to the designers of this structure, with the result that two joints were adopted, separating the length of structure into three separate units. The joint, 1½ in. wide in each case, is located on the center line between east and west columns, the floor construction being supported by cantilever floor-beams spaced 5 ft. 6 in. c. to c. A detail of typical cantilever member is shown in the drawing of the expansion joints.

The joints were located in this manner to avoid any possibility of frictional resistance, which has so often proved a detriment in other structures when sliding plate or roller bearing joints failed to fulfill the assumptions of the designers. Twin columns separated by joints were considered undesirable and awkward in appearance. At the time of writing this description, observation showed that the joints had lessened in width a maximum of ¼ in. from the original measurement of 1½ inches.



PLAN OF SIXTH FLOOR OF BEVO BUILDING IS TYPICAL

All interior columns of the building are round and reinforced with hooping. They vary from 40 in. in diameter in lower story to 26 in. and 24 in. in the upper two stories. In order to facilitate the design and ordering of steel bars, all columns in the lower stories were designed for identical loads, assuming the maximum condition of machinery weights on fifth and sixth floors as well as the omission of many columns in sixth story. The final distribution of machinery and column omissions were not fixed at this stage of the design, which accounts for maximum assumptions made in computations. The lower-story columns are designed for a total dead- and live-load of 1,500,000 lb., being 40 in. in diameter and reinforced with twenty-six 1¼-in. round longitudinals and $\frac{9}{16}$-in. round spirals with 2-in. pitch.

Considère's formula was assumed as a basis for column design, stressing the concrete core to 750 lb. per sq.in., and assuming a modulus of 15.

All exterior columns are square, varying from 33 x 33 in. in the first story to 21 x 21 in. in the upper stories. The lower- or basement-story portion of exterior columns forms an integral part of retaining walls on four sides of building, with the exception of columns along the side opposite the viaduct. All splices of columns longitudinals are secured together by ½-in. U-bolts.

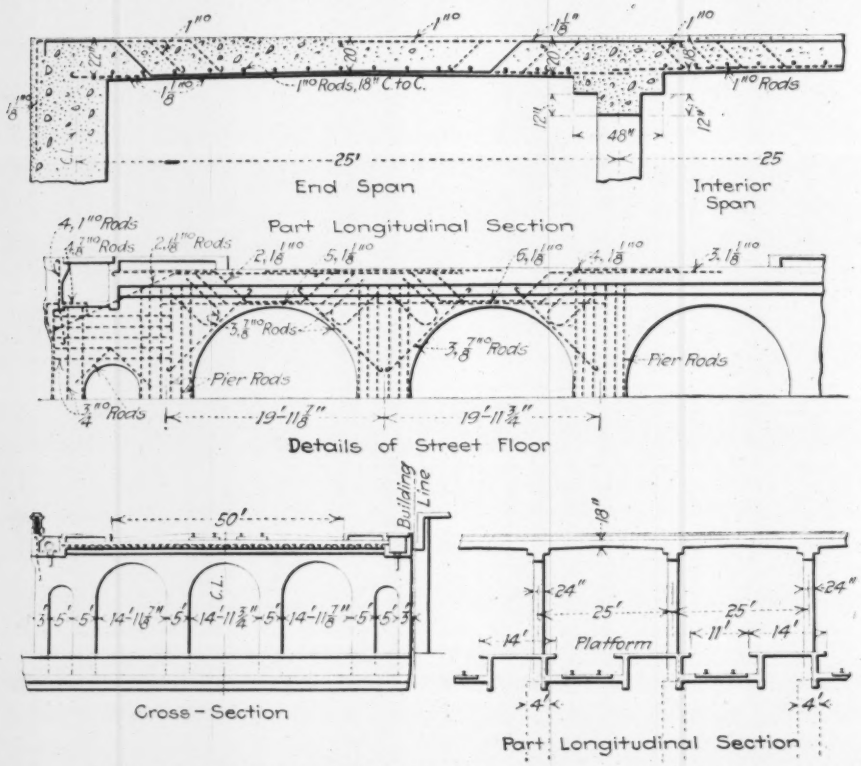
The retaining walls on four street fronts are 30 ft. high, 3 ft. 5 in. and 4 ft. thick, with base 11 ft. wide and 3 ft. deep. They were designed strictly as retaining walls to resist earth pressure, without assuming any lateral resistance offered by the first-floor construction. This method of procedure in design was adopted on account of the unusual depth of story below street grade. Before any other excavation was done, deep trenches approximately 12 ft. wide were dug to solid rock for the reception of the retaining-wall footings. The erection of retaining walls at the beginning of operations for the purpose of holding earth banks intact proved a great advantage in permitting the excavating for lower story to proceed almost simultaneously without interruption and with dispatch.

The expansion joints of the building are extended continuously through the retaining walls to rock foundations. All interior as well as exterior columns are supported on concrete pedestals 7 ft. square extending without exception to solid rock.

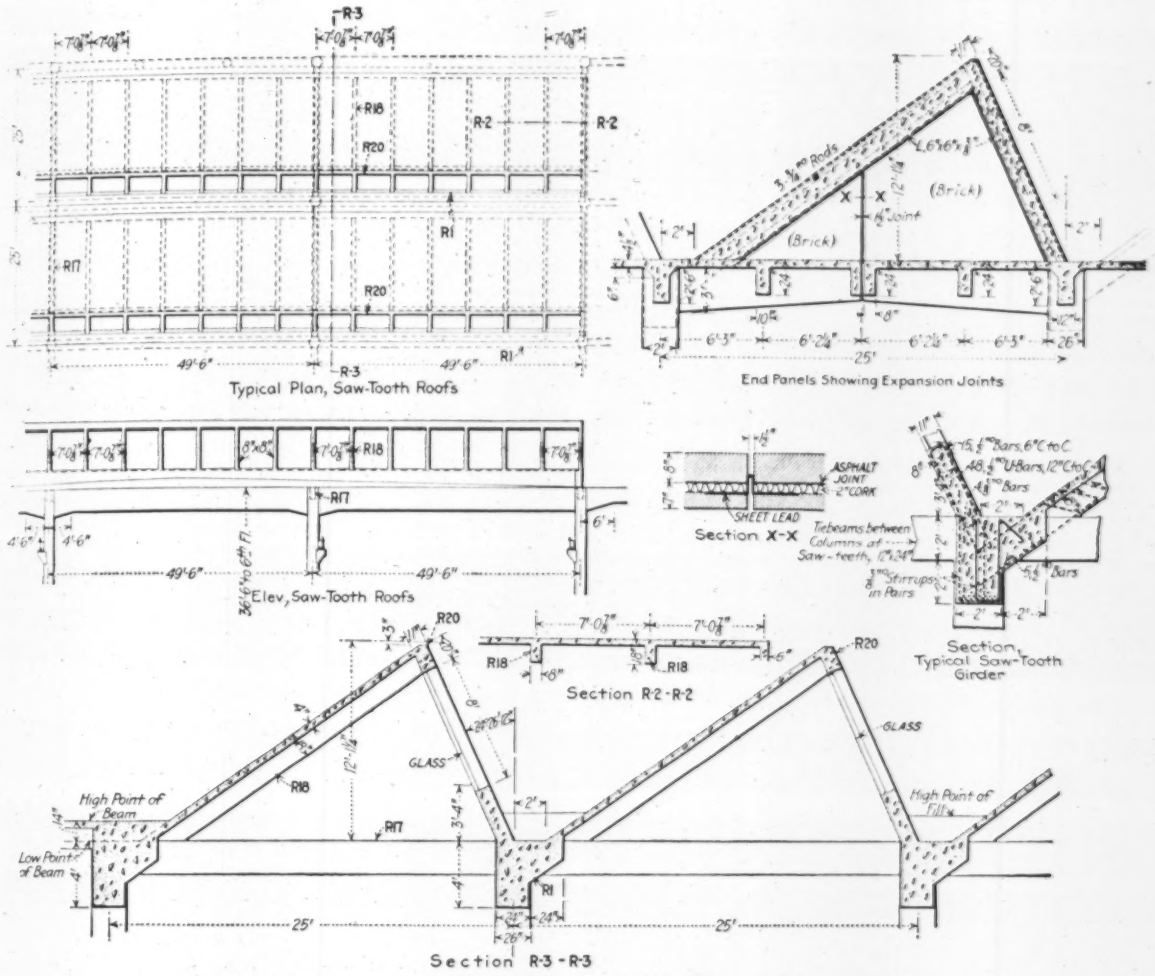
The roof over the balcony openings is of sawtooth construction, consisting of a series of reinforced-concrete girders 25 ft. c. to c. and spanning 49 ft. 6 in. between center lines of column supports. These girders are unsymmetrical in section, 48 in. deep and 24 in. wide. The girders continuous at both ends are reinforced with seventeen 1¼-in. round rods. On account of the excessive lengths of rods that would be necessary to sufficiently provide for negative moments if made in one unit, it was found expedient to splice all the bent rods of the 49-ft. 6-in. girders. The point of splice in each case occurs approximately where positive moment changes to negative at continuous ends. As in the design of other supporting members, all diagonal tension in excess of 40 lb. per sq.in. is resisted by rods bent at 45° with efficient anchorage. Stirrups are also provided.

From the roof layout in one of the drawings herewith, it will be seen that it was somewhat difficult and awkward to establish an effective expansion joint that would be directly in vertical line with the joints below. The joint is continued through the flat portion of roof on both sides of the sawtooth end walls and then up through the end walls, which in this instance consist of brick. All other end walls of sawtooth are reinforced concrete 6 in. thick. At the pinnacle of sawtooth, three ¾-in. rounds additional have been provided; extending into each beam of the inclined roof and into the small columns, the rods being located in the top of the section to reduce the appearance of expansion cracks at this point.

A reinforced-concrete viaduct of simple design was adopted to facilitate erection, by avoiding as much as possible the use of beams or girders in the floor system. Bents consisting of arches and piers 24 in. wide are spaced 25 ft. c. to c. and located directly in line with columns of the building. The slabs between bents are



LONG REINFORCED-CONCRETE VIADUCT CARRIES STREET OVER BASEMENT ENTRANCE



A REINFORCED-CONCRETE SAW-TOOTH ROOF LIGHTS TOP FLOORS

18 in. at the crown and 20 in. at the pier for all spans continuous over two supports and 20 in. and 22 in. respectively for end spans. The continuous slabs are reinforced with 1-in. rounds and 1¼-in. rounds alternating 6 in. c. to c. for a width of 25 ft. symmetrical about the center line of two car tracks above. For roadways and sidewalks the same size bars, 8 in. c. to c., were used.

Pipe spaces for electric conduits, water mains, gas mains, etc., are concealed beneath sidewalks along both sides of the viaduct. The top slabs of these pipe chambers, which also form a part of the sidewalks, are made removable for future convenience should it become necessary to replace broken pipe or place additional pipe line.

The viaduct is 375 ft. long by 81 ft. 9 in. wide, with two expansion joints 1½ in. wide, each located 100 ft. from each end. A joint 1½ in. wide is also provided on the west side, separating the viaduct from the building. All piers or bents are carried to solid rock foundations.

The question of adequately supporting and spacing bars in a reinforced-concrete building has been conspicuously absent from the requirements of most specifications in the past. The erection of a building employing constantly from 100 to 200 iron workers, some skilled and others unskilled, made it imperative to eliminate as much as possible any uncertainty in the proper execution of this vital part of the work. Every slab and beam bar in the building is held up from the forms and spaced according to the engineer's design, by means of Securo supports and spacers. The results have been gratifying and most effective.

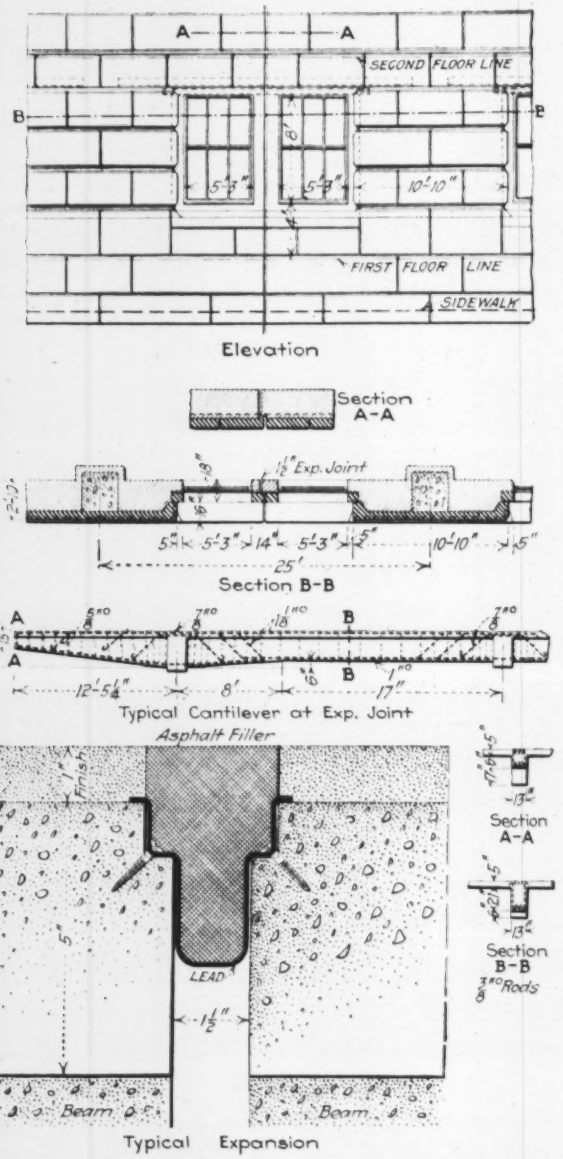
The exterior of all four sides is architecturally harmonious in design, consisting of a 6-ft. granite base, buff Bedford rusticated limestone facing in the first two stories, red mat brick with wide raked joints in the upper stories. The cornice is of buff-colored terra cotta with wide overhang and terra cotta brackets. The entire interior of building in all stories will be faced with white enameled brick, a feature that will add considerable light, besides presenting an immaculate appearance.

The construction will be as fireproof as modern practice will allow, consisting in the aggregate of reinforced concrete, brick, stone, terra cotta, metal windows with wire glass, steel stairs with fire-wall inclosures, metal doors and trim throughout. Nine inclosed emergency stair towers furnish ready egress from the building in case of emergency, while an electrically operated escalator is provided from the first floor to the top story for the use of employees coming to and leaving work. In addition to freight elevators for materials, electric

elevators for the exclusive use of officers of the company and guests will be provided.

Unexcelled toilet accommodations, wash and shower rooms, locker rooms and lunch rooms will be installed in the most convenient localities throughout the building for the use of all employees. A well-arranged modern clinic with every appointment designed to meet all emergency cases is located in the first story. Heating, ventilating, electric-lighting and sprinkler systems are installed throughout the plant and are operated exclusively by electric power.

On account of the convenience offered by an old railroad switch entering the third panel from the north end of the building at the first floor level, provision was made in the design to retain this switch on a temporary wood trestle until the completion of the structure, to permit cars of material to enter the building and deposit their contents direct into bins located immediately south of track. Two gravel bins, each with a capacity of 1500 cu.yd., and one sand bin capable of storing 2000 cu.yd. are located near two 30-cu.ft. mixers. The sand and gravel of the bins are fed direct to the mixers by gravity. Two towers, each 310 ft. high, accommodating a 30-cu.ft. hopper, elevate the concrete to any desired height and through chutes inclined about 3 in. to the foot the mixture is conveyed to any part of the building.



EXPANSION JOINTS DIVIDE LENGTH OF BUILDING INTO THREE PARTS

The arrangement of the plant has proved most efficient, and at no time have the two mixers failed to keep pace with the carpenters and other trades engaged in erecting falsework, placing steel bars, etc., preparatory to concreting.

The structural design for the entire plant was prepared by W. J. Knight & Co. and F. C. Taxis, Associate Engineers. Windmann & Walsh and Klipstein & Rathmann are the associate architects.

The general contract is being executed by the Gilsonite Construction Co., of this city, of which L. J. Haenni is the Vice President and General Manager.

Due credit is given Dr. Rudolf Gull, Chief Chemist of the Anheuser-Busch Brewing Association, for his superior ability and initiative in dictating the general arrangement and future operation of machinery units, chutes, conveyors, etc., the proper distribution of which was so essentially fundamental to the correct execution of the design, to fulfill the requirements of a comparatively new and original enterprise.

New Port and Railway for Brazil

Additional railway facilities and a new port in the State of Sao Paulo, Brazil, are included in a project for developing the port at San Sebastian and constructing a railway from that city inland to Campinas and Pouso Alegre. At present the only line from the coast is the Sao Paulo Ry. from the port of Santos to Jundiahy, 86 miles. There it connects with lines reaching interior points, including Campinas. This present line surmounts the Serro do Mar, the steep coast slope of the great tableland, by means of the famous cable inclines of 8 and 10% grades, described in *Engineering News* of Nov. 23, 1916, p. 976.

The San Sebastian Ry. is to be about 350 miles long, with the Brazilian standard-gage of 5 ft. 3 in. The ascent of the Serro do Mar will be accomplished by a 20-mile section with very steep grades (but the actual grade is not yet determined). This section, it is estimated, will cost about $150,000 per mile. For 12 miles from the port to the foot of the incline, and for all of the line beyond the summit, the cost will be about $40,000 per mile. The port of San Sebastian is said to have the advantage of a depth of 60 to 160 ft., while at Santos large steamers cannot enter on account of shallow water. The cost of the new harbor works is estimated at $3,756,000.

Concessions for these works have been asked from the government of Brazil by Luiz Barretto Filho, civil engineer, of Sao Paulo, and it is hoped to interest American capital. The necessary funds cannot now be raised in Brazil and the war has prevented a French syndicate from undertaking the project.

War and Sanitation at Public Health Convention

Abstracts of Papers on State Laboratories, Saving City Refuse in War Times, Activated-Sludge Process, State Control of Garbage Disposal, Presented Last Week at the Annual Meeting of the American Public Health Association in Washington, D. C.

State Public Health Laboratories in Time of War

By Dr. Henry Albert

Iowa City, Iowa; Chairman Laboratory Section, American Public Health Association

As a result of a questionnaire sent to every state, territorial and provincial public health laboratory of the United States and Canada, comprehensive data were obtained on the service already rendered by such laboratories in connection with the mobilization of troops, as well as a survey of the problems confronting such laboratories and the methods by which such problems should be solved. Data were also obtained from the Medical Corps of the U. S. Army and Navy and from the U. S. Public Health Service on the manner in which state board of health laboratories may be useful at this critical time.

The public health laboratories of more than one-half of the states of the United States and the provinces of Canada have made a considerable number of examinations in connection with the mobilization of troops in their respective states or provinces. The principal examinations which state laboratories have been making are for diphtheria, typhoid fever, typhoid and paratyphoid carriers, tuberculosis, meningitis and meningococcic carriers, gonorrhoea, syphilis, malaria and hookworm disease. The making of typhoid vaccine has also been an important activity.

Laboratories Prepared To Do Field Work

More than one-half of the state public health laboratories are prepared to do field work, including water examinations and other diagnostic bacteriological examinations and the investigations of epidemics. This phase of laboratory service should be made possible in every state and province. It is highly desirable that all states except the smaller ones should have branch or coöperative laboratories, in order to serve best the communities situated at a considerable distance from the central laboratory, and, more especially, communities in the neighborhood of rather permanent encampments of soldiers. A movable laboratory will serve to a certain extent and in many instances may be even more serviceable than stationary plants.

The work of many state health laboratories has already been hampered by the enlistment of some of the staff in the Medical Corps of the Army and by the calling of others by the draft. It seems very important that the efficiency of the state health laboratories should be increased at this time rather than diminished. Training for this kind of service requires considerable time. It is therefore very desirable that the selective draft should provide for the leaving at their posts of duty of those who are greatly needed in the public health laboratories of the country.

Owing to insufficient appropriations, a number of laboratories are unable to meet all the war demands. No time should be lost in making good the deficiencies, nor should more liberal appropriations cease with the end of the war. After the war there will be need for strong, vigorous, efficient men and women for constructive health work.

Activated Sludge Promises To Solve Packing-House Wastes Problem

By Langdon Pearse

Division Engineer in Charge of Sewage Disposal Investigations, Sanitary District of Chicago

Activated-sludge plants for the treatment of packing-house wastes have been tested by the Chicago Sanitary District, using 75% packing-house and 25% domestic sewage, by a number of individual Chicago packing houses and by packers at Fort Worth, Tex. The following notes are based on experiences at the various plants.

The best tank arrangement has not yet been determined. The Sanitary District has tried two schemes. In one the sludge is aërated entirely in contact with the sewage; in the other, the sludge and sewage are aërated for a short time and the settled sludge is reaërated and resettled before return to the initial point. The latter arrangement has shown somewhat smaller requirements in the amounts of air needed, and a reduced volume of sludge to be returned.

Air Requirements and Distribution

At the plant of the Sanitary District 4 cu.ft. of air per sec. per gal. of sewage is apparently sufficient to produce a virtually stable effluent in summer weather. In winter, with the same amount of air, the effluent is of lower stability, when tested by incubation at room temperature. If a stable effluent is then required, 6 cu.ft. or more of air per gal. of sewage may be needed, according to the temperatures of the sewage and air.

The distribution of the air appears at present to be served best by the use of filtros plates. Perforated pipes have been tried both at Chicago and Fort Worth. More air is required than with the filtros. The ratio of gross area of plate to tank area at Chicago was 1 to 6.3, with net area of 1 to 8. At Fort Worth, 1 to 7 has been used.

The experience of the Sanitary District indicates that the settling period may be short, ½ to 1 hr., depending vitally on the condition of the sludge and the season of the year, and that the bottom slopes of hopper bottom tanks should be about 60 degrees with the horizontal. Velocities should be low.

In the Sanitary District work, with screened sewage, exclusive of screenings, about 46,500 gal. of liquid sludge, containing 99.2% water, accumulated per 1,000,000 gal. of sewage over a period of nine months. This is equivalent to 2420 lb. of dry solids per 1,000,000 gal. The amount of dry solids appears to vary between 1100 and 4500 lb., exclusive of screenings. The screenings caught on a 30-mesh screen will vary from 500 to 1200 lb. of dry material per 1,000,000 gal. of day flow. During a period of 6.5 months the reduction of suspended matter was 2820 lb., as against a sludge removal of 2680 lb. of dry material per 1,000,000 gal.

The essential point is to remove the water. With very liquid sludge, direct filter pressing is difficult, owing to the large amount of liquid to be handled. Preliminary treatment by settling with or without acidification is very helpful. Quiescent settling from 3 to 6 hr. will reduce the moisture content to 98 or 98.5%. The addition of about 6 lb. of sulphuric acid per 1000 gal. of sludge (containing 98% moisture) seems to aid in filter pressing, and makes a sludge which leaves the cloths cleaner. A 2.5-hour pressing with acid-treated sludge is equivalent to 3½ to 4 hr. of pressing with settled sludge. Acid-treated sludge apparently keeps better and shows a higher nitrogen content.

Effect of Acid

The effect of acid on activated sludge is not at all the same in different places. On the Sanitary District sludge, the effect of acid is apparently a minimum, whereas at Fort Worth, on packing-house activated sludge, the addition of acid produces a rapid coagulation, with immediate flotation of the sludge, the moisture content being reduced quickly. The water used in the packing houses there is very high in alkali. The sludge can be reduced further by drainage and retreating to about 85% moisture or lower. This phenomenon does not occur at Chicago. Furthermore, it is estimated at Fort Worth that about 11,000 lb. of dry material can be recovered per 1,000,000 gallons.

Plain settling has considerable value in reducing the moisture content. However, its effectiveness depends on the condition of the sludge. The settling is not as marked as on domestic sewage at Milwaukee or on packing-house sewage at Fort Worth.

Filter pressing has been tried by the Sanitary District on a small "Simplex" press, with plates 15 x 15 in., loaned by the Simplex Ejector Co. and demonstrated by W. Buckley. This press was the one used at Milwaukee, with the addition of six radial ribs on each plate. The plates in the press have perforated steel strainer plates over the corrugations. Cakes from ⅞ to 1½ in. have been made by 2 to 4 hr. pressing, with pressures varying from 20 to 150 lb., according to the character of the sludge and the preparatory treatment. Occasional steaming helped in keeping the cloths clean. The moisture content of the cake was varied, in general being around 80%.

Fertilizer and Grease Values

There appears to be considerable fertilizer value in activated sludge. Analyses show a high nitrogen content, compared to the screenings. Occasional analyses show press cake, particularly with acidified sludge, running from 5 to 6% of nitrogen on the dry basis.

The value of fine screening as a treatment preliminary to aëration is worth consideration. Our experiments show that a 30-mesh screen will remove from 500 to 1200 lb. of dry material per 1,000,000 gal. of day flow. The screenings contain about 80% moisture after natural drainage. The nitrogen content is low, equivalent perhaps to barnyard manure. In fact, the material is largely paunch manure. From the operating standpoint, the removal of this material by screens seems desirable, as it is largely inert, of vegetable origin and slow to decompose. From the standpoint of handling the sludge, however, when the screen is running the sludge is somewhat harder to press. The screenings seem to act as a fibrous binder which aids pressing.

General indications at Chicago show that grease and fertilizer may be recovered. The grease may be worth about 4 and 7c. a pound at normal and war prices. The activated sludge, dried, if containing regularly 5% of ammonia, may be worth about $12 per ton dry, under normal conditions, or possibly $18 per ton under present war conditions.

The activated-sludge testing plants operated at Fort Worth, at Chicago by Armour & Co. and by Sulzberger & Co., and by the Sanitary District, have been remarkably free from odor. The sewage tested in all cases has been fresh.

Further development in the activated-sludge process appears to lie along the lines of reducing the amount of air used, of improving the settling tanks, and of the more rapid reduction of water content of the sludge. Such development will tend to reduce both construction cost and operating charges.

Ways and means of reducing more rapidly the water content of the sludge should be studied, either in preparation for filter pressing or as a direct preliminary to drying. This is a complex problem, verging on the domain of physical chemistry.

The activated-sludge process offers better promise of a solution of the problem of treating packing-house waste than any other that has been suggested.

Effects of the War on Garbage Production and Disposal

By I. S. Osborn

Head of the Division of Utilization of Food and Household Wastes, U. S. Food Administration, Washington, D. C.

THE EFFECT OF THE WAR on the production and disposal of garbage has become very apparent during the past nine months. At the present time the question is a vital one. The education of the public in food conservation is tending to change the problem of garbage disposal. What the ultimate result will be is uncertain, as we are just beginning to realize that a great change, which no doubt will revolutionize this branch of sanitary engineering, is taking place.

Returns to the United States Food Administration show that in 60 cities there was an average decrease of from 12 to 15% in garbage collection in the first nine months of this year, although in some cities an increase over previous years is shown. Some of the decrease is due to less thorough public collection, and some to more extensive private collection for pig feeding or for reduction. The increase would have been considerably

greater, it is believed, except for the large amount of vegetable wastes going into the garbage pail from home gardens.

The amount of grease recovered from garbage is a better indicator of saving than the quantity of garbage collected. The actual percentage of grease per ton of garbage shows a reduction of approximately 15%. No doubt there has been a greater reduction in the consumption of meats than is indicated by the decrease in the amount of grease recovered from garbage. At virtually every meat market, scraps, gristle, rind and bone, which were formerly trimmed off and sold to rendering companies, are now pushed off on the purchaser at the price of edible meat. Evidence of this is found in the reduced amount of scraps purchased by rendering companies.

Pig Feeding for Small Cities

The current methods of garbage disposal are burial, dumping, incineration, feeding and reduction. Burial and dumping are carried on at low cost, but they produce no revenue and unless proper attention is given to them they are likely to create a nuisance.

Until recently there has been a strong tendency toward incineration, especially among the smaller cities. This method, in nearly every case, has been followed at considerable expense to the municipalities, both for installation and operation, with no returns except in the very few cases where power has been developed—but in most instances the cost of power development has been greater than the revenue obtained.

There is now a strong tendency to adopt some method of garbage utilization instead of incineration. Garbage piggeries will be found desirable in many cities. Each thousand population produces food wastes sufficient to fit 25 hogs for market. At the present price, a ton of garbage will produce from $7 to $8 worth of pork. In the smaller communities, no other method of garbage disposal will show returns as desirable from an economic viewpoint as feeding garbage to pigs.

For the larger cities, no doubt garbage reduction will prove to be the most advantageous method. The decrease in quantities of by-products will to a large extent be offset by their increased values, and at the same time there will be a tendency to recover additional by-products that now are lost.

There is an ever-increasing demand for the tankage produced from garbage, for use in the manufacturer of fertilizer. The price of nitrogenous fertilizer is determined by the available nitrogen. The old form of tests showed a low available nitrogen in garbage tankage, but the soil tests now made by the U. S. Department of Agriculture show that the material decomposes readily, affording a rapidly available nitrogen supply

Garbage By-Product Values Run to Millions

The values of the by-products from the existing garbage reduction plants, at present prices, will amount to $8,500,000 for grease and $2,250,000 for tankage. From the tankage can be produced annually about 9,000,000 lb. of nitrogen, 25,000,000 lb. of bone phosphate lime and 2,500,000 lb. of potash. The grease that is recovered is split up into various by-products, the glycerine content being the most valuable. From the garbage grease produced in the plants operating in the United States, 8,000,000 lb. of nitroglycerine can be extracted, and still leave grease from which can be made approximately 200,000,000 twelve-oz. cakes of soap.

There is a great shortage of the materials that can be produced from garbage. Utilization is not solely a question of profit. Every community should utilize its wastes and make available from this source everything which may be gained thereby for the country's needs.

The food problem will not end with the war. The shortage of fats and fertilizer will continue for years. The installation of proper methods of garbage utilization will be not only a present help, but also a benefit in future years. The public will not forget soon its present lessons in economy. Never again will it waste so much through the garbage can as it has wasted in the past.

State Health Boards Should Control City Refuse Service

By Edward D. Rich
State Sanitary Engineer, Lansing, Mich.

SEVERAL STATES have laws giving to their boards of health supervision of sewerage and sewage disposal. It would seem that similar supervision of the collection and disposal of municipal refuse would result in valuable assistance to cities and towns in solving disposal problems economically and in accordance with the best practice. If it did no more than protect municipalities from the unscrupulous vender of untried or worthless devices, it would accomplish enough to justify its existence.

In order to see that sanitary principles are not violated in carrying on the work, the law should require that the methods and specific plans of procedure proposed must receive the approval of the state board of health before the work is begun. The statute should also give the board power to order such changes in equipment or methods as may be necessary to prevent nuisances or protect the public health, or even to require the installation of an entire system if local circumstances are such as to demonstrate its need.

Inquiries made in Michigan showed as an average for eight cities having municipal collection of garbage that only 60% of the householders took advantage of the service while four cities having private collection showed that less than half that percentage (actually 28%) patronized the collector. These figures agree with general observations. From the viewpoint of nuisance, garbage claims the attention of the municipality before the other waste products, but from the standpoint of the spread of disease, street cleaning is, no doubt, of first importance, and should certainly come within the scope of a state law enacted to cover all forms of city wastes. The lack of system and efficiency noted above in regard to garbage collection and disposal undoubtedly would be found to apply to street cleaning were a similar investigation to be undertaken. To any one familiar with what is possible in this line, the methods pursued almost universally are little less than disgusting and it would seem that state supervision is the only means by which material general improvement may be accomplished in cleaning streets with a minimum of cost and a maximum of sanitary efficiency.

Bridge Spans Moved Endwise To Rest on New Piers

Increased Length of New Union Pacific Drawspan at St. Joseph Necessitated Shifting Fixed Spans 140 Feet—Pneumatic Caissons Used for Foundations

MOVING three long truss spans of a railway bridge to rest on new intermediate piers was involved in the improvement of the Missouri River bridge at St. Joseph, Mo. Defective condition of the substructure necessitated the building of new piers. An increase in length of the drawspan necessitated a change in the position of the piers and the consequent shifting of the fixed spans to their new positions, the bridge remaining on the old center line. The superstructure, which was built in 1904, is in good condition and safe for carrying modern traffic and loads.

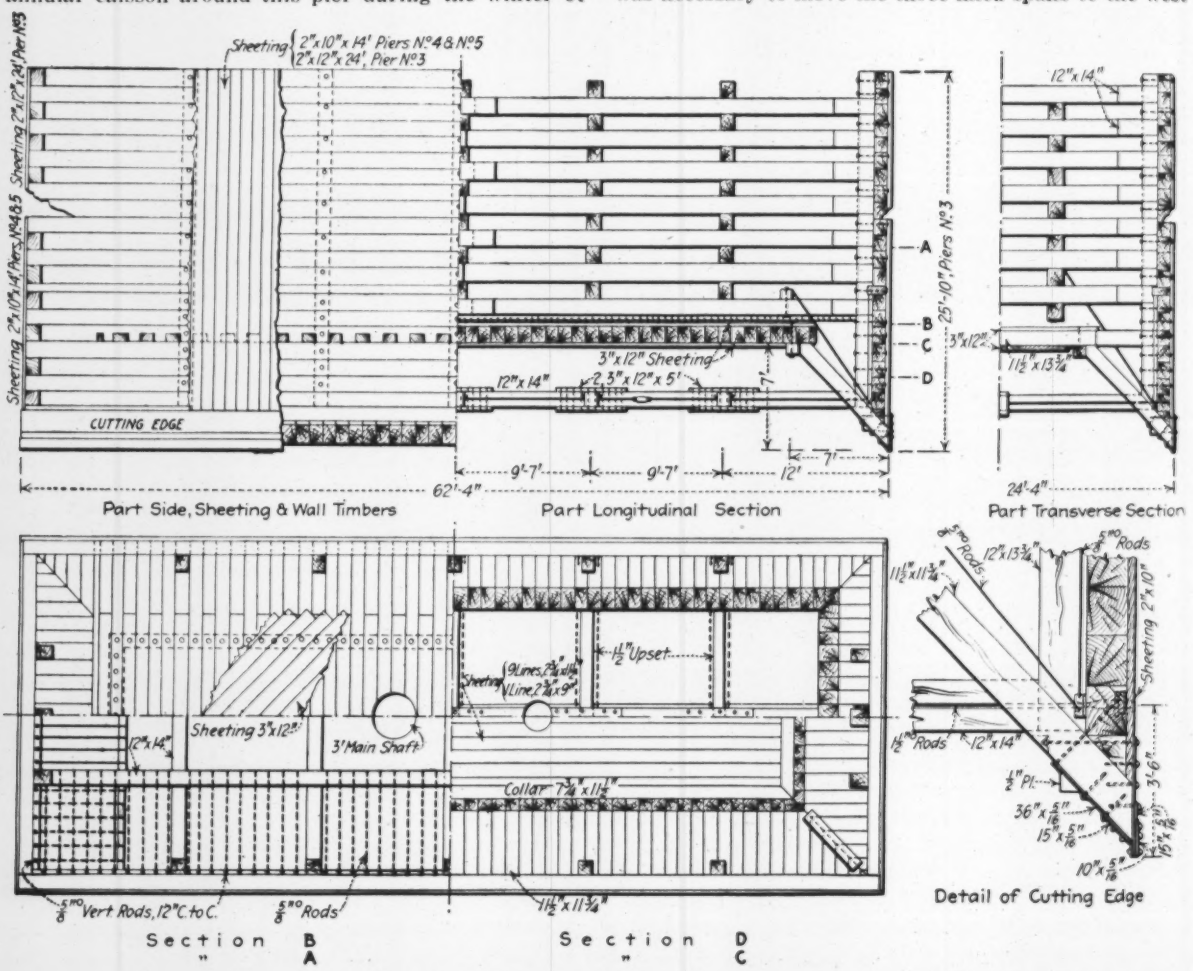
The bridge is that of the St. Joseph & Grand Island Ry., which is a subsidiary of the Union Pacific system. It consists of a 465-ft. swing span (replacing the old 358-ft. span), with three truss spans of about 297½ ft. c. to c. of end pins at the west end, and two girder spans at the east end.

The pivot pier was first found to be in poor condition. This is attributed by the engineers mainly to improper foundations and scouring around the base. Plans were drawn and construction started to build an annular caisson around this pier during the winter of 1915-16. An early movement of a large field of ice, which formed just above the bridge, destroyed the caisson just before it was to have been landed. Further investigation showed that the other piers were in bad condition, but not so bad as that of the pivot pier.

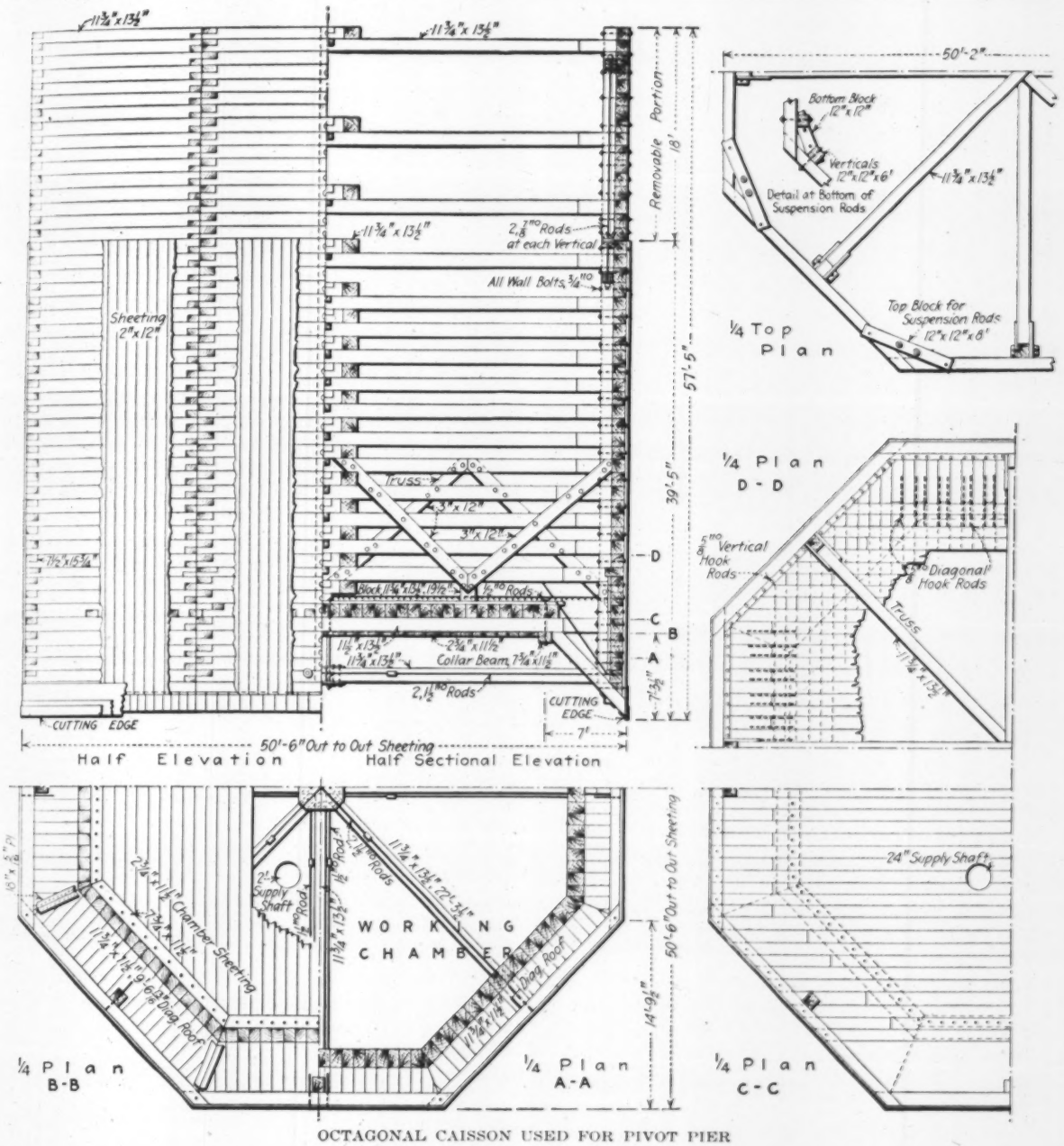
After much consideration had been given to the repair of the old piers, it was decided at first to build new piers in line with the down-stream from the old ones, and to shift the spans laterally to the new position.

Plans were submitted to the War Department on this basis, but the requirements of the Department would not permit moving the old drawspan to new piers. The old span provided openings only 150 ft. wide. The War Department ruled that the company must furnish a drawspan giving two openings 200 ft. in width at low water. This was probably on account of the swift current at this point, and also because several accidents to steamers occurred at this bridge some years ago. This 200-ft. width is also specified for the opening at a bridge recently built over the Missouri at Kansas City.

To provide for the extra length of the new draw, it was necessary to move the three fixed spans to the west



TYPICAL RECTANGULAR CAISSON


Half Elevation
Half Sectional Elevation
50'-6" Out to Out Sheeting
CUTTING EDGE
Removable Portion
Sheeting 2" x 12"
Truss
All Wall Bolts, 3/4" ø
2, 7/8" ø Rods at each Vertical
2, 1 1/2" ø Rods
Collar Beam, 7 3/4" x 11 1/2"
Block 11 1/4" x 13 1/2" x 19 1/2"
50'-2"
Bottom Block 12" x 12"
Verticals 12" x 12" x 6'
Detail at Bottom of Suspension Rods
Top Block for Suspension Rods 12" x 12" x 8'
1/4 Top Plan
1/4 Plan D-D
5 1 1/8" ø Vertical Hook Rods
Diagonal 1 1/8" ø Hook Rods
24" Supply Shaft
WORKING CHAMBER
Drag Roof
Chamber Sheeting
1/4 Plan B-B
1/4 Plan A-A
1/4 Plan C-C

OCTAGONAL CAISSON USED FOR PIVOT PIER

to new piers, and to keep the alignment of the new bridge the same as that of the present bridge. This plan made use of the fixed spans, but required moving them about 140 ft. lengthwise. The new masonry consists of seven piers constructed by the pneumatic process, and one pier and abutment supported by piles. The piers are of reinforced-concrete, designed for a single-track superstructure. The new and old arrangements of the bridge are shown in one of the drawings. The new swing span is 56 ft. wide, with trusses spaced 18 ft. 6 in. c. to c. In the fixed spans the trusses are spaced 17 ft. c. to c.

The pivot pier is 31 ft. in diameter under the coping, with octagonal footing courses and an octagonal base 50 ft. 6 in. wide. The upstream rest pier, at the head of the fender, is of flat-iron shape, with a width of 42 ft., and a length of 49 ft. 8¾-in. from the rear face to the pointed nose. The piers for the fixed spans are rectangular in plan. Old piers 2, 3 and 4, in the channel, will be cut off at about 6 ft. below low-water level. The others will be cut off at about the extreme low-water level.

The caissons have the sides of the crib and the roof of the working chamber built of 12 x 14-in. timbers, thoroughly drift-bolted together and calked. The working chamber has sloping sides, the ends of which are shaped for the attachment of the steel cutting edge. The roof is designed of sufficient strength to take the weight of a reinforced-concrete beam built over it. This beam takes the load of the pier during the sinking, until the caisson is landed and sealed. The caissons are sunk to bedrock, which is found to be a clean hard

NEW DRAWSPAN AND OLD AND NEW POSITIONS OF FIXED SPANS

limestone, overlaid usually with 3 to 4 ft. of gravel. The depth to rock is about 52 ft. below low water and 80 ft. below base of rail. The rock surface across the river bed varies several feet in elevation. Each caisson has a 36-in. main shaft and a 24-in. supply shaft.

The octagonal caisson for the pivot pier is 50 ft. 6 in. over the 2 x 12-in. vertical sheathing and inside the cutting edge. Its construction is shown in one of the drawings. The roof of the working chamber has two courses of 12 x 14-in. timbers, with 3 x 12-in. sheathing on the inside and on the top. Over the top sheathing is the concrete bed, reinforced by ½-in. horizontal bars spaced 6 in. c. to c. in both directions. Inclined and vertical rods extend into the triangular mass of concrete filling behind the sloping sides of the roof. Within the working chamber each side is braced by a radial timber strut 12 x 14-in. with a 1½-in. tie-rod on each side of this timber. Above the roof the crib is braced by eight radial timber trusses, built up of 3 x 12-in. plank.

The total depth of the caisson is 57 ft. 6 in., with a working chamber 7 ft. 3½ in. high in the clear. The upper part of the crib is a removable section 18 ft. deep, secured to the permanent part by ¾-in. vertical rods 26 ft. long. Across each corner of the top of the removable section is a diagonal timber through which the suspension rods are passed, and on which they are held by nuts and washers. The lower ends of the rods of each pair are secured in a similar manner. They pass through a short crosspiece fitted beneath a pair of 12 x 12-in. verticals, 6 ft. long, which are bolted to the wall timbers of the crib, as shown.

The caissons for the other piers are of generally similar construction, but are rectangular in plan, and have only a single course of 12 x 14-in. timbers for the roof. The caissons for piers 3, 4 and 5 are about 62 x 24 ft., and the others are about 48 x 24 ft. In these the working chamber, 7 ft. 3 in. high, is braced at mid-height by one central longitudinal strut and five cross struts. Each is a 12 x 14-in. timber, with a 1½-in. rod on each side.

The caissons for piers 1, 2 and 7 were built in a pontoon of octagonal shape, 60 ft. in diameter and 9 ft. high. The bottom, on which the caisson rests, has 16 holes 3 in. in diameter, fitted with plugs. When the caisson is completed to a height of about 12 ft., these plugs are removed, allowing the pontoon to fill with water. One side of the pontoon, which is fitted with hinges, is then lowered, and the caisson is floated out. The movable side is raised, the water pumped out, and the pontoon is then ready for the building of the next caisson.

The caissons for piers 3 and 4 were built on platforms near the west bank of the river. These were supported on screws by means of which the platforms were lowered into the water so that the caissons could be floated off. The caissons for piers 5 and 6 were built in place on the ground, as they were located above ordinary high water.

At the end of August, 1917, piers 4, 5 and 6 were completed, and piers Nos. 1 and 3 had been sunk to rock. The timber caisson for Pier No. 7 had been built up to a height of 30 ft. and floated into position. The construction of the caisson for pier 2 (the pivot pier) had been commenced. Considerable difficulty was experienced in sinking pier 1, on the St. Joseph shore, on account of riprap. The other piers were sunk in very short time. It is expected to complete the work on the piers by the middle of October.

The contract for constructing the piers is on a basis of a lump sum for the work of sinking the piers and unit prices for all other items, involving an expenditure of about $350,000. The railway company furnishes the cement, reinforcing steel and lumber, except the form lumber. The contract was let to the Missouri Valley Bridge & Iron Co., of Leavenworth, Kan., covering a design by that company which figured cheaper than that of any other plan submitted.

The contract for fabricating and erecting the new drawspan and moving the old fixed spans has been let to the American Bridge Co. The plans for the caissons and steel work were prepared in the offices of the Union Pacific Railroad.

This work is being handled under the direction of E. E. Adams, consulting engineer, and R. L. Huntley, chief engineer of the Union Pacific R.R., as consulting engineers for the St. Joseph & Grand Island Ry. A. C. Everham, terminal engineer, has general supervision of the work and H. M. Stone is assistant engineer in immediate charge.

Motor Traffic on Pennsylvania Roads Shows an Enormous Increase

THAT an enormously increased tonnage is passing over Pennsylvania's main highways, due to the rapid increase of motor-truck traffic, is indicated by a report submitted to Commissioner O'Neil by the automobile division of the State Highway Department. The heavy traffic on state roads, particularly the Lincoln Highway, by the enormous freight trucks now running, has already begun to play havoc with the highways, according to the department. In certain sections this important route has begun to break and probably will have to be rebuilt next spring.

When the present roads were built it was never thought that they would have to support so immense a tonnage as is now passing over them daily. If the increases indicated by this survey continue for the next few years, especially in motor-truck traffic, the highway problems in Pennsylvania, state highway department officials predict, will assume such proportions as to dwarf many other big questions with which the commonwealth will have to contend. This subject was dealt with in one of its phases in an article in *Engineering News-Record* of Oct. 11, p. 704, giving the views of William D. Uhler, chief engineer of the State Highway Department.

Registration of Motor Vehicles

The following are the official statistics on number and character of motor vehicles in Pennsylvania:

There is 1 motor vehicle for every 27 inhabitants and 7 motor vehicles for every 2 miles of public roads. Motor license receipts from Jan. 1, 1917, to Sept. 30, 1917, aggregated $3,204,606, as against $2,268,942 for the same period in 1916, or an increase of 41%. An increase of nearly 38% is shown over the fees derived from these sources during the entire year of 1916, when the total was $2,325,057.50.

Registrations of motor vehicles for the first nine months of 1917 exceeded, in all classes, those for the entire year of 1916. Solid-tired motor vehicles, weighing from 4000 to 5000 lb., show the largest increase in any class, as 3084 have been registered, as against 1550 during 1916, or an increase of nearly 100%. Solid-tired motor vehicles, weighing from 5000 to 10,000 lb., numbered 8078; in 1916 the number was 5163. Trucks, weighing from 10,000 to 15,000 lb., increased during the same period from 1582 in 1916 to 2360, while the class weighing from 15,000 to 24,000 lb., numbered 1631, as against 1081 during 1916. The lighter trucks, weighing less than 4000 lb., showed an increase of only 121 over the registrations for 1916, when 1933 were registered, 2054 being the number for 1917.

During the year 1915 there were 8139 solid-tired motor vehicles registered in the state; in 1916 the number was 11,732; for 1917, as of Sept. 30, there are 17,726. The figures for 1917 show a greater proportionate increase in the heavier types of trucks. During this same period the registration of solid-tired motor vehicles increased over 51%, as compared with 1916 figures, while that of pneumatic-tired motor vehicles increased only 36 per cent.

Pneumatic-tired motor vehicles showed a greater increased registration in cars of lower horsepower, the registration of vehicles under 20 hp., increasing 43%; those from 20 to 34 hp., 36%; from 35 to 49 hp., only 12% and the ones above 50 hp., 25%. There were 297,660 pneumatic-tired motor vehicles registered this year, while in 1915 the number was 152,024 and in 1916 there were 218,846.

There were 2720 tractors registered as against 2701 during 1916, a gain of only 19; of these 15 were free registrations. Trailers increased from 496 in 1916 to 806, showing a further development in this new phase of transportation over the state highways. Motorcycles gained only about 12%. There were 24,062 registered, while the total for the year 1916 was 21,439.

Rapid Sand Filtration Recommended for Catskill Water Supply

A RECOMMENDATION of the rapid sand or mechanical type of filtration for the Catskill water supply is contained in the 1916 annual report of the New York Board of Water Supply, just issued. That portion of the report dealing with the subject of filtration is as follows:

"The year 1916 saw a practical conclusion to the preliminary studies made to decide the type of filtration plant to be constructed at the Eastview site, two miles east of Tarrytown. In the course of these studies the board's engineers visited and inspected plants in actual operation in Washington, Baltimore, Philadelphia and Little Falls as well as other plants of less importance.

"A summary of the investigations indicated that, apart from variations which have been introduced in the fundamental methods of operating such plants, there were, in fact, only two general types to be considered: Slow-sand filtration and rapid-sand (frequently called mechanical) filtration. While the opinion of the engineers on the staff of the board, and of experts specially retained, was somewhat divided respecting the two methods, the fundamental proposition that either type will do the work effectively and provide efficient treatment of the Catskill supply is generally admitted, the difference of opinion being based on collateral or related matters, and not at all upon the basic proposition involved. All things considered, the adoption of the rapid-sand or mechanical type of filtration was recommended as best suited to meet the conditions encountered, for the following reasons:

Reasons for Choice

"1. Numerically, by far, the largest number of all those consulted favored a mechanical plant.

"2. It appears to be conceded that, considering interest, sinking fund, operating and maintenance expenses, the yearly charges for conducting either type of plant would be about the same; whereas, the first cost of construction and installation indicates a saving of approximately 25% in favor of the rapid-sand type. The item thus saved is estimated, in round numbers, at two million dollars.

"3. It appears that mechanical filters can be most readily modified to conform to strange or unexpected conditions; that they are more quickly responsive to requirements, and by the very nature of their construction can be better and more quickly adapted to met every state of the water they may be called upon to treat.

"4. The factors involved in the labor problems have also an important bearing, as in the case of the mechanical filter a small, trained force is kept continuously engaged; whereas, the slow-sand plant involves the employment of a considerably larger force at more or less uncertain times and frequently when exigency arises, which, in a very large municipally-operated plant, would probably result in great complication and uncertainty.

"5. It has been established that mechanical filters will require for their construction a materially smaller ground area.

"6. It is to be noted, also, by statistics obtained from the United States Department of Commerce and labor, that since 1908 only three slow-sand filters were constructed anywhere in the United States, and none whatever since 1910, and it is conceded that the mechanical branch of the art has very rapidly developed in the last ten years, during which improvement in the design and construction of filters of this type has been very marked.

"7. It is conceded, further, that the handling of the sand for cleansing in the mechanical plant is much quicker and more flexible than in the slow-sand type.

"8. Since the inauguration of the work on the Catskill aqueduct about ten years ago, methods of sterilization have been devised which are almost universally applied in connection with both types of filters and as adequate means of sterilization intended to make the water safe against disease have been provided, the question to be decided became to a large degree one of clarifying the water, which it was determined will be efficiently accomplished with a mechanical plant."

Freight Belt Line and Terminals for St. Paul

New and Existing Lines To Be Linked Up to Form an Outside Route—Local Freight Yards Part of Project

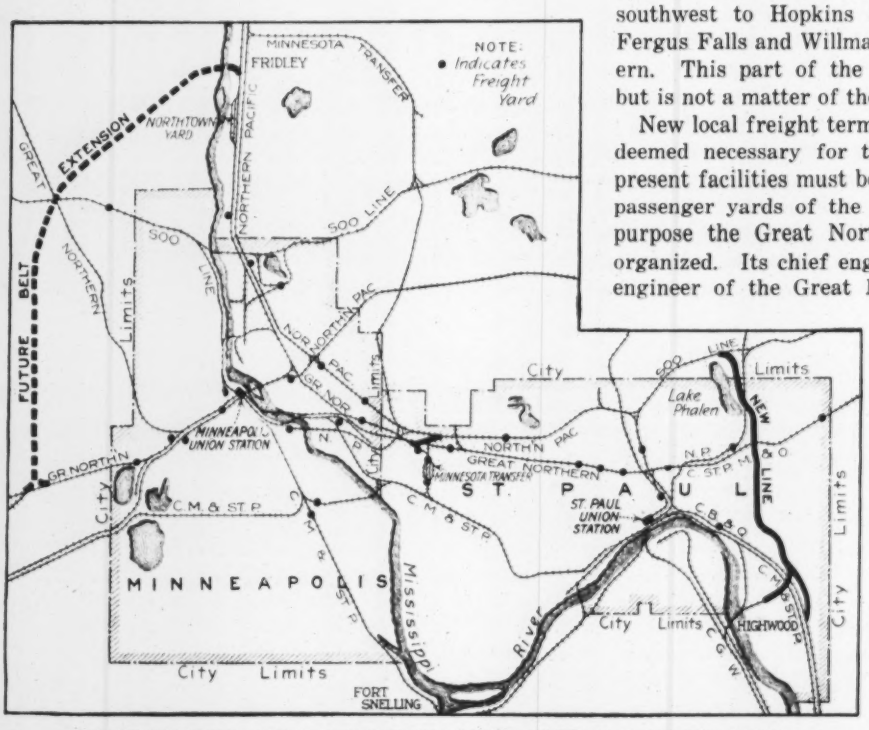
DIVERSION of through freight traffic around the City of St. Paul is to be effected by the Twin City Belt Ry. The purpose is to keep local terminals and the new Union Station line clear of this traffic. The new line will thus facilitate the handling of passenger traffic and through and local freight traffic and relieve the congestion at this very large railway center. The company is controlled jointly by the Great Northern Ry., Northern Pacific Ry. and Chicago, Burlington & Quincy R.R., and the line will serve a number of the railways centering at this point. The chief engineer is M. A. Butler, who is now with the army, being constructing quartermaster at Camp Dodge, near Des Moines, Iowa, as noted in *Engineering News-Record* of Aug. 16, p. 300.

The present and future parts of the new route are shown on the accompanying map. The first part of the project is the construction of a road six miles long from Highwood, on the Chicago, Burlington & Quincy (southeast of St. Paul), northward to Gloster, on the Soo line. The latter road will be utilized for about two miles west to the connection with the Northern Pacific. This road will then be used for about six miles, and then a new short link will afford connection with the Great Northern at Minnesota Transfer, which is northwest of St. Paul.

The maximum grade on the new line will be 0.8%, while the present line out of the Great Northern freight terminals at St. Paul has a grade of 1.75%. The line is in rolling country and the excavation will average about 125,000 yd. per mile. It is intended to build the roadbed and structures for double track, but to lay only a single track at present. Streets will be crossed by girder spans carried on reinforced-concrete abutments and bents on the curb lines. It is hoped to get some construction work done this season.

A prospective extension of the Belt Line provides for a diversion of through freight traffic around the City of Minneapolis. For this the Great Northern would be used from Minnesota Transfer to the new yard now being built at Northtown, a few miles north of Minneapolis. There a new line would extend approximately southwest to Hopkins Junction to connect with the Fergus Falls and Willmar divisions of the Great Northern. This part of the project is shown on the map but is not a matter of the near future.

New local freight terminals and yards at St. Paul are deemed necessary for the Great Northern, since the present facilities must be removed to make way for the passenger yards of the new Union Station. For this purpose the Great Northern Terminal Ry. has been organized. Its chief engineer is A. H. Hogeland, chief engineer of the Great Northern Ry. The immediate expenditure is expected to be about $300,000. Land for these new terminals has been obtained in the neighborhood of Eighth and Pine Sts., but definite plans of the layout have not yet been decided upon. Part of the site will be utilized for freight houses and yards and part for the development of a manufacturing and industrial district, the various establishments of which will have direct railway service.



NEW BELT LINE AND CONNECTIONS AT ST. PAUL AND MINNEAPOLIS

St. Maurice River-Control Works Are Nearing Completion

A 70,000-Yard Dam Will Create the Largest Reservoir in North America—Construction Difficulties Arose from Isolation of Site—Attractive Camp Built in Bush

THE MASONRY DAM which is being thrown across the St. Maurice River in Quebec to create the largest reservoir in North America is 80% completed. The work has been pushed with dispatch in spite of difficulties in securing deliveries of material and in the employment of labor, and in spite of the isolation of the dam site—170 miles north of Montreal in unsettled bush which heretofore has been traversed only by the wandering Indian, the lumber cruiser and the fur trader.

This work has been projected for many years, as the regulation of the St. Maurice River is of the greatest value to the important developed powers at La Tuque, Grand Mère and Shawinigan Falls. But there are many undeveloped power sites, and the equitable assessment of the cost of the regulation work was not possible until after the creation of the Quebec Streams Commission as a provincial conservation body. This commission investigated the possibilities of regulation, designed the dam, let the contracts and issued bonds to cover the cost.

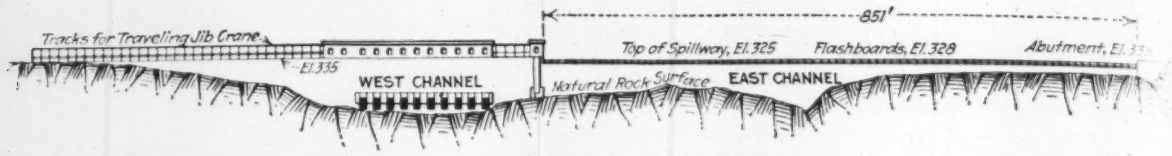
As noted in *Engineering Record*, Oct. 10, 1914, and *Engineering News*, May 11, 1916, the interests back of the great Shawinigan power development organized the St. Maurice Construction Co. to bid on the work, insuring by this connection the early and careful completion of the project. This company employed Fraser, Brace & Co., of Montreal and New York City, as supervising engineers of construction.

The general plans for the dam are shown in the accompanying sketches. Some changes are noted over the earlier descriptions which have been published. There is now no power plant at the dam. The log sluice has been moved 45 ft. west into the east channel—and the permanent sluices have been moved 20 ft. west to accommodate this change. Also the stilling pool and measuring weir, 300 ft. downstream from the dam, have been eliminated.

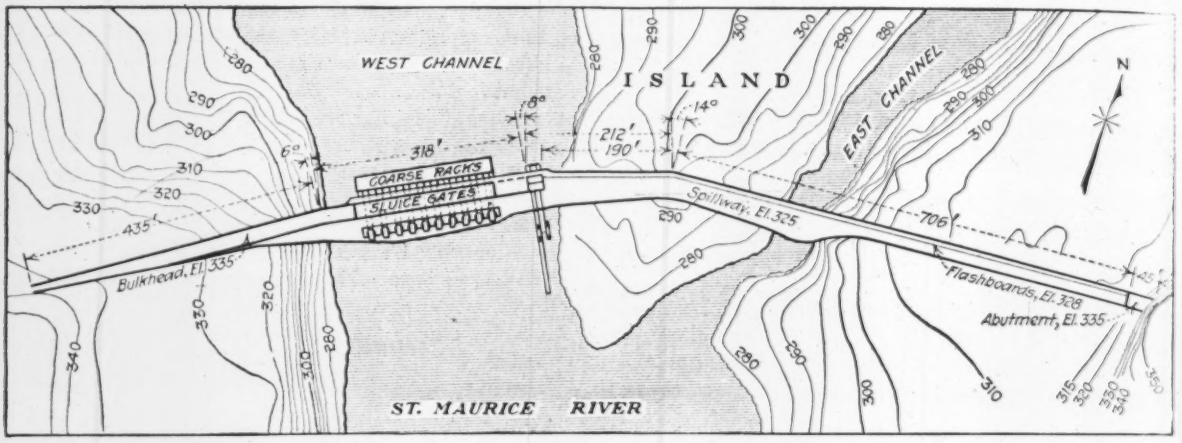
The permanent sluices through the dam are of interest. Steel conduits of square cross-section and sloping bottom have been embedded in the masonry from the gate chambers down to the outlets. The gates themselves are simple steel frames and are hand or motor operated.

The nearest railway connection is the Canadian Government Ry. (National Transcontinental Line) 128 miles north of Montreal. The St. Maurice River is navigable for light-draft boats for 32 miles above the railway, although there is much swift water. The river has been used for all of the material and supplies needed. For covering the final 20 miles from the head of navigation to the dam site, a standard-gage railway has been built, employing a 3½% maximum grade and 17° curves—uncompensated. The rails used on the main line and for general work around the dam have been about 60-lb. The railway equipment includes six dinkies (one 35-ton at the railway base, two 27-ton for quarry trains and three 25-ton for

THE ST. MAURICE LOG COFFERDAMS WERE REMARKABLY TIGHT



Downstream Elevation



SOME CHANGES HAVE BEEN MADE FROM THE ORIGINAL PLANS AS PUBLISHED

supply and gravel trains), 20 flat cars, two box cars, one 6000-gal. fuel-oil tank car, 35 6-yd. side-dump cars, and two railway-type steam shovels (which since the completion of the railroad have been used at the quarry and at the sand pit opened up).

Up to July, 1917, the company had accumulated two stern-wheel towboats of 3½-ft. draft, one river tug, five gasoline launches, one "alligator" towboat, one gasoline tow and 24 scows of 18-in. draft, 12-ft. beam and 60- to 80-ft. length overall. The larger of these scows had a capacity of one car of cement, which for convenience in handling was loaded in 50-sack skips. The "alligator" tow is a peculiar craft (see photographs)—a twin-screw wood-burning steam barge carrying 5000 ft. of cable on a large drum geared to the engine. The cable is made fast to a tree at the head of the rapids and as the boat descends it lays the cable on the channel bottom.

The contract was signed on July 25, 1915, and the contractors put four survey parties in the field to investigate the river and the railway routes. Quick decisions were made and railroad construction was begun in September, 1915.

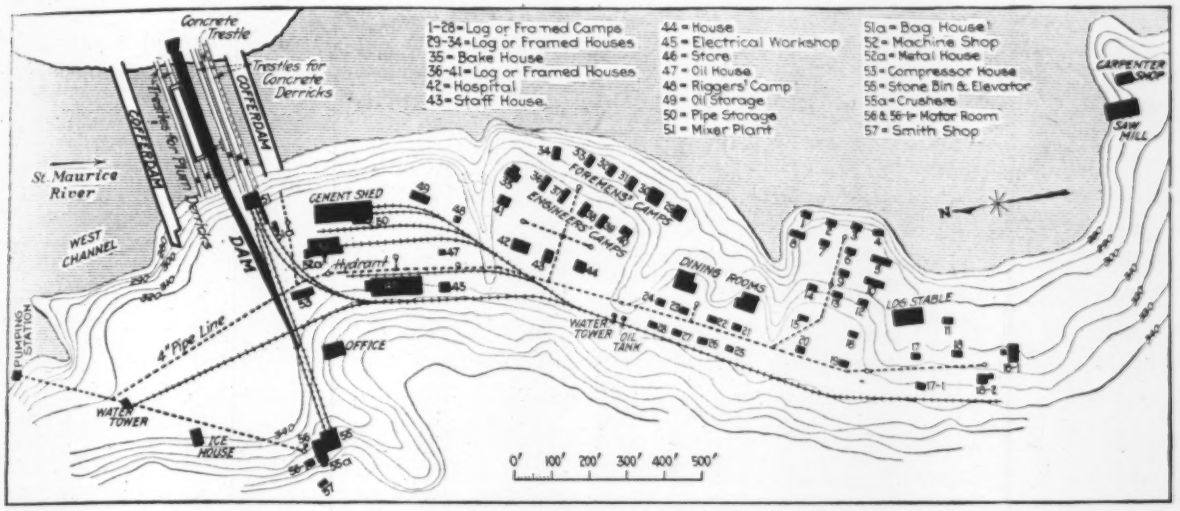
Nine hundred men were at work on the railroad early in October and there was great difficulty in taking supplies up the river for so many. The river was at a low stage, the country was scoured for light-draft boats to take in supplies, supplementing the boats which were being built on the work. The climatic conditions were so severe, including rain and snow almost every day, that tents were of little use and comfortable shacks had to be provided all along the railroad. Gangs of bush men followed up the engineers, building camps in readiness for the construction gangs. A telephone line was run over the entire 50 miles following up the clearing gang on the railroad right-of-way.

During the following winter season it was possible to continue some railroad work, to build a temporary hydro-electric plant, to get the siding yard and camp built at the railway base (Sanmaur on the National Transcontinental) the camps and yard at the transfer station from river to rail (Chaudiere Rapids) and the camp at the intermediate point where the "alligator" was stationed (Nine-Mile Rapids). During the first winter the camp at the main dam site was carried along. Three million feet of logs were also cut and hauled and the sawmill started.

The river froze over on Nov. 5, and from that date until the following May all materials had to be hauled over snow roads which drifted badly in the slightest wind. The power house machinery and sufficient equipment to begin work at the dam was then hauled in at very great expense.

In the spring of 1916 the great scarcity of labor due to munition work made it very difficult to obtain men. This condition resulted finally in the almost complete suspension of this class of work in Canada. However, the same rush of munition work, with insistent demands for hydro-electric power, made it more important than ever to complete the dam. Therefore the power interests behind the contractors determined to complete the dam. The contractors procured labor from the internment camps to replace the Italians who had been called home to fight. But this labor proved expensive and inefficient. Ever since, there has been great difficulty and expense in keeping sufficient labor on the work. The railroad was finally completed on Aug. 12, 1916, six weeks behind the contractors' schedule. To catch up, the contractors put in additional plant and arranged to work during the second winter.

To avoid the transportation of fuel for the work the contractors built the hydro-electric plant already referred to, at a point two miles below the dam site. Here in one branch of the river, where it divided, a concrete substructure was built and the tailrace and headrace channels were deepened and a head of about 18 ft. was obtained.



A GOOD SITE EXISTED FOR AN ATTRACTIVE CAMP

Two 350-kv.-a. 2400-volt three-phase direct-connected horizontal-shaft units were installed. Two 2400-volt circuits were run to the dam site, where the power is stepped down on various transformers to the voltage required for the motors. This plant was completed on Aug. 1, 1916. This plant proved just large enough to operate the plant during the past summer.

With the steam plant hauled in during the winter, work was started in the east channel at the dam site in May, 1916. Cofferdams were thrown across the east channel to unwater that part of the dam and concreting this section of the dam started in September.

In placing the concrete across the east channel, arrangements were made to carry the entire flow through this channel and to coffer the whole west channel at one time. Five temporary sluiceways were left to be controlled by stop logs. The rest of this part of the dam was stopped at El. 293, to provide a flashed spillway for floods which the sluices could not pass. After the west cofferdam was completed the entire flow of the river was turned through these sluiceways. The west channel coffer and those sluiceways permitted the storing of 100,000,000 cu.ft. of water which insured good navigation for this summer when the bulk of the cement was taken up the river. The regulation was successful and will result in the completed dam beginning business this winter with a substantial storage of water already on hand for use in February and March which are low water months in this region.

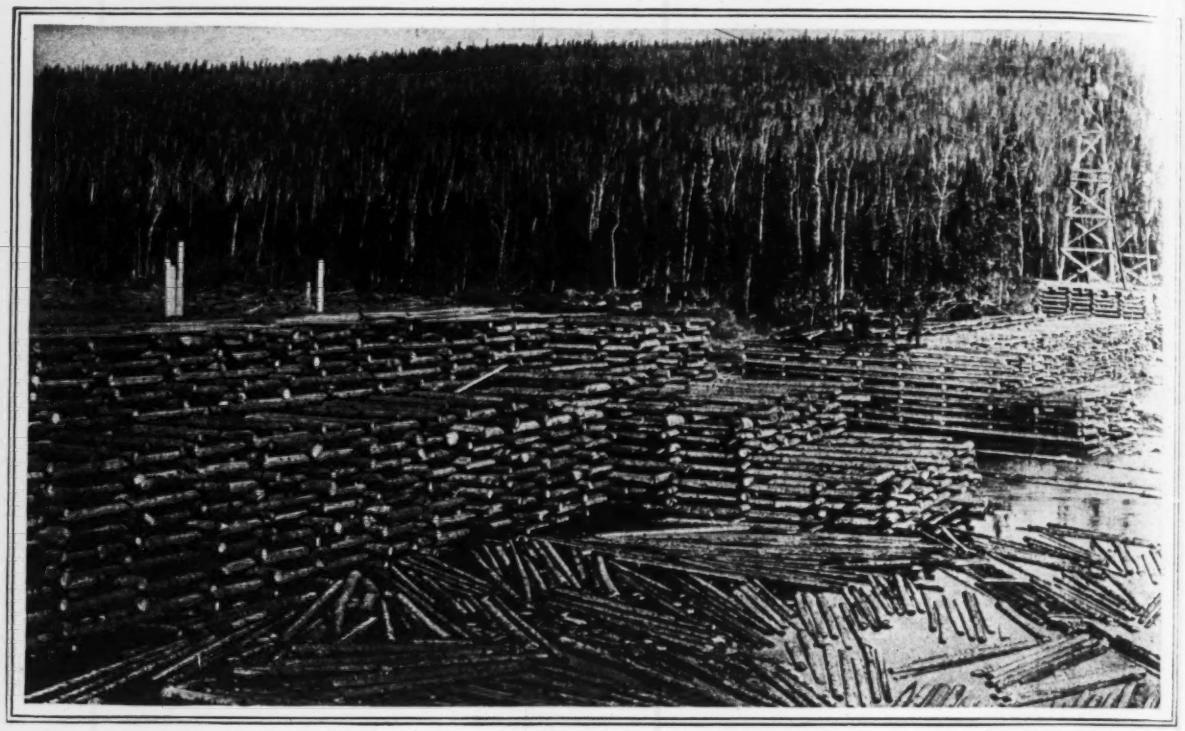
The construction of the upstream coffer in the west channel was one of the main features of the contract. Work was started when the west channel was passing about 10,000 sec.-ft. of water at a velocity of 5 ft. per second. Both the upper and the lower coffers were begun in August, 1916. They were built in three pieces; two shore lengths with a 60 x 60-ft. closing key to be placed when the sluices in the east channel were ready.

These coffers were log cribs, framed floating, and scribed to fit the bottom as found by close soundings. The green timber sank by the weight of the framing above—plus a few weighted platforms. Once down the crib was filled and backfilled with rock and sheeted on the pressure faces.

Work on the east end concrete and on the unwatering of the west channel occupied the open season of 1916 and the winter of 1916-17. The coffer filling and construction of the trestles for tracks of the four stiffleg traveling derricks and the narrow-gage concreting tracks were pushed along in spite of temperatures as low as 49° below zero. Ice up to 6 ft. in thickness inside the cofferdams was cleared to rock for the trestle bents. Earth and rock excavation in the deepest part of the west channel was begun in March, 1917. The first concrete in the west channel of the dam was placed in the middle of April. Up to Sept. 1, 58,000 cu.yd. had been laid out of a total of 73,000 in the completed dam. Moreover, this includes practically all the difficult work. Thirty thousand yards were placed during the two months ending Aug. 31 so that the entire amount is expected to be in place by the end of the present season. The work will thus be completed on contract time although the contract quantities have been very largely exceeded. It should be noted also that the increase occurred in the foundation where it could not be foreseen and it taxed the organization to keep up with the schedule.

The timbers were framed up in 10 x 10-ft. panels with a whole section floating to fit the bottom profile as found

A "CROCODILE" PULLED THE BARGES THROUGH RAPIDS



COFFERDAMS WERE FRAMED UP FLOATING TO FIT THE RAGGED BOTTOM WHEN SUNK

by soundings. A floating section was anchored by upstream cables while being sunk. The key sections were framed up floating near the shore and were towed into place and sunk. The rock fill for coffers proceeded out from the west shore—a track being laid from the fill quarry to and upon the crib. Run of quarry was put in, including the overburden. As the rock fill proceeded the sheeting followed. Care had to be used that the sheeting did not proceed too rapidly in advance of the backfill, as on one occasion, when the sheeting was pushed ahead, a small deflection resulted.

The upstream coffer backed up the water until it overflowed the stop logs in the east-channel sluices, creating a head of about 40 ft. on the bottom of the upstream west coffer and giving a head of about 56 ft. on the lowest rock excavation. But the entire leakage is so small that it is handled by a 10-in. centrifugal pump run below normal speed.

The great expense of bringing in cement made placing plums desirable. Two quarries have been opened up; a lower one for plums and a high-level one for crusher supply. Derricks and hand labor are used in loading the plums into skips after shooting. A steam shovel places the quarry run for the crusher on 6-yd. side-dump cars, which are switched to an inclined cable hoist. For both quarries the company uses 12 tripod drills and nine hand hammers, the latter for breaking up larger pieces.

The rock is a blue granite, which reduces in the big crusher to a large proportion of small sizes. At the top of the crusher house is a 54 x 36-in. Buchanan jaw crusher discharging to a No. 7½ Telsmith gyratory, from which the stone goes to a screen and the rejections pass to a No. 3 and a No. 4 Austin crusher. The jaw and No. 7½ crushers are each driven by a 75-hp. induction motor; the No. 3 has a 25-hp. and the No. 4 has a 30. The quarry car hoist is back-belted from one flywheel of the large crusher.

Provision has been made for dumping hand-picked rock on a bypass platform from which it can be shot past any of the upper crushers that may be temporarily out of service.

After the screen was used for a short time, run-of-crusher was permitted to be used directly for concrete. The average quantities of natural sand to be added for a proper mix (1:2½:5) were determined, and care is taken in drawing from the bins to get an average mixture on each car going to the mixer plant.

Two 1-yd. Chain-Belt and one Ransome mixers are installed, discharging into 1¼-yd. bottom-dump buckets on narrow-gage cars drawn by horses or small oil-burning steam dinkies. From these cars the buckets are taken by two 5-ton 60-ft. stiffleg derricks, each on two cars. There are also six 65- to 75-ft. guyed derricks scattered about the work.

Special attention has been paid to securing a high percentage of plums, a low-level quarry having been opened, as noted, for this purpose and a direct track run from it to advantageous places. The percentage of plums has run this summer from 10 to 25%, and it is expected that 35% will be reached. To secure this, careful planning is necessary, and good teamwork between the mixing, placing and train gangs.

Rock and sand from the crusher unit are lifted by a steel bucket conveyor (Link-Belt) 80 ft. to bins of 600 cu.yd. storage capacity. Difficulty has been experienced in getting rock from the quarry fast enough to fill the bins. For conveying rock to the mixer, two cars are kept on parallel tracks leading down on a 2% grade

to the top of the mixer. They are connected by a cable running over a sieve at the end of the bin, so that the loading car going down pulls up the empty. The rock goes into small bins above the measuring hoppers of the mixers.

At the mixer, sand is dumped from the pit yard directly into six-car bins with wooden grizzly top at track level. In the winter a 3000-yd. sand-storage pile is maintained close by. Cement from the mixer auxiliary storage is dumped into a measuring hopper and on signal let down through a tin-lined wood chute into the sand and stone previously let into the mixer hopper in desired quantities.

All the repair work is done at the dam site, and here are maintained the machine and forge shops as complete as the needs have shown necessary. In it are found a double spindle, 24-42-in. lathe, 18-in. lathe, 20-in. shaper, 20-in. drill press, two-wheel emery stand, 6-in. machine hacksaw, ½- to 2-in. bolt machine, 2½- to 6-in. pipe machine, three coal-burning forges and three oil-burning forges. In a separate building is a motor-driven air compressor furnishing 1100 cu.ft. of free air at 100 lb. pressure (for drills and oil forges).

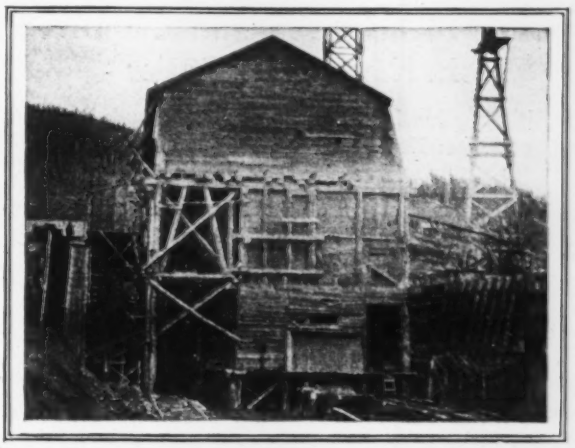
The St. Maurice Construction Co. for the work has at the railroad base (Sanmaur) a five-track yard beside the river and a dock with a transfer derrick and 10-ton

ABOVE THE MIXERS WERE THE ROCK AND SAND BINS WITH A DUMP-CAR SHED ON TOP

steam hoist. Here are coal-storage bins, cement and supply warehouses, etc. There have been about 45 men in this camp, including the boat crews, but accommodation is provided for up to 100 workmen coming or going to the dam site.

At the transfer station from river to railroad there is a four-track yard on a bluff above the boat landing. Here a 10-ton derrick is used to swing the cargo directly from boat to yard. Cement, coal and supplies can be stored in small quantities. About ten men are kept here to check and transfer 150 tons of material per day.

At the dam site there are six yard tracks, not including the sand and rock tracks on which, entirely or largely, are operated dump cars for the supply of local



THE CRUSHERS FED ROCK BINS OVER TRANSFER TRACKS

materials. There is storage for 50,000 lb. of cement and warehouse room for seven months' provisions.

The main camp layout is shown. The houses are of logs calked, lined and sheathed. (The camp of the Quebec Streams Commission is on the opposite side of the river and houses only the engineers, inspectors and camp employees of the commission.)

The company boards the men, charging $25 a month for quarters and meals. Only about 25 men have families there, and these are mostly engineers and foremen. To these the company store sells supplies, and a few dollars house rent is charged.

The camp is "bone dry." Not only are no alcoholic beverages sold, but a rigid guard is maintained to prevent liquor from being brought in by incoming men. No cash transactions of any sort are carried on at the company stores. The men are paid monthly by check and all supplies from the store are charged, even to postage stamps at the post office. In this way a check can be kept on the use of food and supplies, which are brought in with some difficulty and expense.

The company maintains a small hospital, and a doctor is in constant attendance. There have been very few accidents and little sickness.

The St. Maurice Construction Co. is organized with Julian C. Smith, vice president and chief engineer of the Shawinigan Water and Power Co., as president. C. E. Fraser, president of Fraser, Brace & Co., supervising engineers, is managing director of the St. Maurice Company. J. J. McCarthy has been general superintendent in charge of all work. His assistants are John Menzies, master mechanic, George Bullock, chief electrician, E. A. Egar, paymaster, L. J. McNally, storekeeper and Charles Luscombe, resident engineer.

The work has had the close attention of O. Lefebvre, Chief Engineer of the Quebec Streams Commission whose resident engineer is J. B. D'Aeth. The great interest taken in this first great conservation structure undertaken by the Province of Quebec, is shown by the fact that Premier Sir Lomer Gouin and most of the Cabinet as well as the Hon. S. N. Parent, Chairman, and all the members of the Commission have made the long journey necessary personally to inspect the work at critical stages.

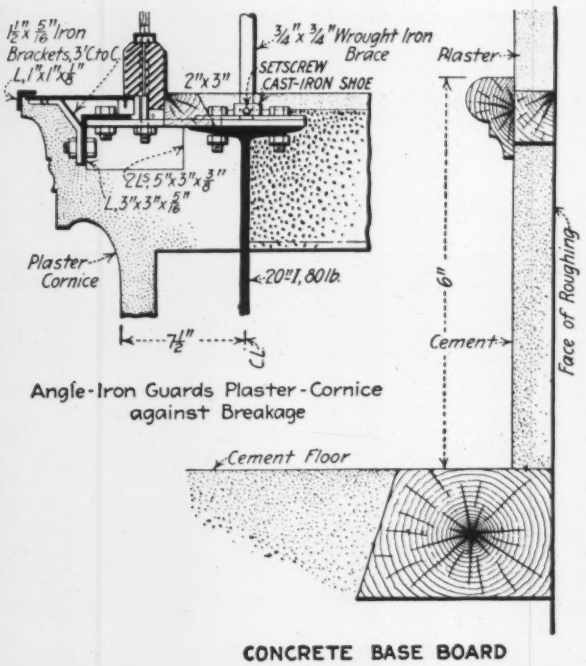
Minor Structural Details Improved in New Hotels Statler

Partitions, Baseboards, Stair Treads and Ballroom Floor Details Were Developed in Successive Designs

IN THE construction of the Hotels Statler in Cleveland, Detroit and finally in St. Louis, the architects, George B. Post & Sons, have worked out a number of small details both of structure and fittings. Some of these details, as installed in the latest hotel now nearing completion in St. Louis, may be applicable to other buildings of the same or similar character.

The floors throughout are of flat tile arches, with a 3½-in. cinder-concrete fill and a 1-in. surface of 1:3 cement mortar troweled smooth. In bathrooms and service rooms the usual tile surfacing was applied, but in the bedrooms and corridors a special baseboard and carpet nailing strip was placed. In the bedrooms, as shown in one of the details herewith, the wooden baseboard has been omitted and a 5½-in. strip of 1:3 cement mortar has been plastered on the partition blocks instead. This base strip was found to be cheaper and easier to apply than the usual wood base. Above the mortar strip is a wooden chair guard molding tacked on wooden grounds, and below the strip is a 2 x 2-in. tacking strip set into the concrete floor, for the carpet.

In the corridors the detail is varied by the use of a base of precast terazzo, which takes the place of the baseboard and extends out into the floor with a sanitary cove to the tacking strip. Corridor carpets are then tacked inside their edges and cover the joint between the strip and the terazzo.



CONCRETE BASE BOARD

UPPER LEFT-HAND VIEW, STEEL ANGLE TO GUARD PLASTER CORNER OF CORNICE. RIGHT-HAND VIEW, PORTLAND CEMENT BASEBOARD AND WALL-TACKING STRIP

The partitions throughout the later hotels are of hollow clay tile. In the Cleveland house gypsum-block partitions were used, with gypsum plaster facing on each side. On account of some shrinkage in the gypsum blocks this plaster cracked at the junction of the partitions with the outside walls. In the bathrooms also, where face tile was applied to gypsum blocks, cracks developed in the tile throughout the entire building. This condition was apparently caused by the use of uncured blocks.

To avoid this condition in the later houses, terra cotta was used as a backing for all tile work.

In the ballroom of the St. Louis hotel an innovation in flooring has been made. This is the use of tar joints in the rough flooring. The base floor is of rough boards nailed to sleepers set in the cinder concrete but placed ¾ in. apart. Into this joint tar is poured, the matched maple flooring laid, tacked to the lower boards. It is believed that this detail will give greater resiliency to the dancing floor and prevent creaking.

The detail drawing herewith shows a steel edging put on the corners of interior balconies to protect the plaster cornice there from damage by cleaners' ladders. This edging is a 1 x 1 x ⅛-in. angle riveted to a plate which forms part of the steel structure on which the plaster cornice hangs. In previous structures these cornice corners have been found to be easily broken or disfigured.

The stairs between upper floors are of course only occasionally used, so the tread finish may be rough. A pressed steel form of stair is used, in which a unit comprises a riser and the next lower tread, the riser extending about 1½ in. above the tread plate. The tread proper is then formed by a 1½-in. layer of either magnesium oxide or 1:3 portland cement mortar, which is screeded flush with the top of the riser plate and a small projection in the face of the next higher riser. The use of ordinary cement mortar for these treads has proved quite successful.

Light Motor Trucks Replace Heavy Trucks on Sandy Soil

Consideration of soil as a factor in the use of motor trucks on construction work was found necessary in building the army cantonment at Camp Custer, near Battle Creek, Mich. In the early part of the work two companies with 30 to 40 trucks each were furnished by the Quartermaster's Department, U. S. Army. One company had 3-ton trucks and the other had 1½-ton trucks. The soil is sandy and both the main road and the temporary roadways for construction work were soon cut into deep ruts of loose sand that offered no traction for the wheels. The trouble was greater on the grades, where the sand flowed away as the driving wheels revolved. Attempts were made to improve conditions by covering the roads with hay and straw, but this only improved conditions for a few hours. Rain helped for a time, as the wet sand would hold better than the dry.

The 3-ton trucks became stalled so frequently that they were shipped away to other work. The 1½-ton trucks had little difficulty in getting around, even when the sand was dry and loose.

Centralized Engineering Succeeds in Wisconsin

A Dozen Scattered State Engineering Bureaus Were Consolidated Under a State Engineer in 1915—Dual Control of Bureaus Practicable

By Sidney J. Williams
Engineer, Industrial Commission of Wisconsin

THE Wisconsin legislature in 1915 created a Department of Engineering to control all engineering and architectural work done by or for any state department, board, or institution. The experiment was looked upon with misgivings, especially by existing state departments which already had well-organized engineering staffs; while *Engineering News* remarked editorially that the courts might be called upon to determine just what activities should be classed as "engineering." Now, after two years, the department is recognized by law-makers and people as an indispensable and highly efficient branch of the state government. The functions of the department have been largely increased, in some cases beyond the strictly "engineering" field, by Acts of the 1917 legislature and also by the voluntary action of other state departments, some of which were at first hostile to the engineering department.

Broadly speaking, this success has been due, first, to the care which was exercised by the framers of the law in making the department non-political; and second, to the wise policy of John G. D. Mack, state chief engineer (formerly professor of machine design in the University of Wisconsin). Mr. Mack has consistently refused to disturb existing engineering departments and employees who were doing good work, and has declined to force his services and supervision upon other departments whose work was partly engineering, preferring to wait until such departments voluntarily sought his coöperation. This they all did, sooner or later.

System Before 1915

Previous to 1915 the state's engineering and architectural work comprised many bodies and functions. There was practically no coördination between them, except that in a few instances an engineer from one department was assigned to special work for another.

The railroad commission and tax commission joint engineering staff had been in existence 12 years, under the direction successively of Prof. W. D. Taylor, later chief engineer of the Chicago and Alton; Prof. W. D. Pence, who resigned in 1913 to join the engineering board of the Division of Valuation, Interstate Commerce Commission, and C. M. Larson.

The highway commission engineering staff, under A. R. Hirst, was organized in 1907.

The state hygienic laboratory, located at the state university, had made sanitary surveys for the state board of health. This board also included a division of plumbing inspection.

The industrial commission did engineering work in inspection of factories, buildings and boilers.

The university architect, Arthur Peabody, did all the architectural work for the University of Wisconsin, while its engineering work was done by members of the engineering faculty.

Private architects were employed by the Normal School Board, the Board of Control, which manages all the state penal and charitable institutions, and the separate governing boards of the School of Mines, the Stout Institute and the Wisconsin Veterans' Home. The new State Capitol was constructed under the direction of a special commission, which also employed architects.

The Capitol power plant was in charge of a competent operating engineer. The power and heating plants of some of the other state institutions had received some attention from a consulting engineering firm; the remainder (except the university, as already noted) were unburdened by any engineering supervision. At one of these plants it was recently noticed that a section of the lower chord of one of the roof trusses had been permanently removed to permit the installation of a larger boiler.

Engineering Department Created

Combination of all engineering and architectural work into one department was the idea of Governor E. L. Phillip. A man of large business interests, he wished to have these important activities, which involve so large an expenditure of state funds, placed under the control of an organization which would be equal in efficiency to any similar organization in a great commercial enterprise. In property interest alone the state is such an enterprise, as it owns property valued at about $33,000,000. The functions of the engineering department in connection with state-owned property are, however, only a fraction of its total activities.

The bill first introduced was considerably changed at the suggestion of engineers already in the state service. As finally passed, and with minor revisions made this year, it provides as follows:

1. The state chief engineer is appointed by the railroad commission, with the approval of the governor, for an indefinite term. The appointment is thus effectually divorced from political influences, as the railroad commission is a fairly permanent body, the term of only one of its three members expiring every two years. The engineer's salary also is fixed by the railroad commission (with the governor's approval); at present it is $6000.

2. He appoints such assistants as he deems necessary, subject to the approval of the governor, but not subject to civil service rules. Such assistant engineers may be assigned permanently to other state departments where continuous engineering service is required, and may be given appropriate titles, such as highway engineer or university architect. Appointments for such service are subject to the approval of the head of the department concerned.

3. State departments or boards which require temporary or special engineering or architectural services

must requisition the same from the engineering department. Up to the present the state engineer has not interfered with the employment, by certain boards, of private architects working under the general direction of the state architect.

4. All contracts and payments for public works must be approved by the state chief engineer.

5. All heating, lighting and power stations in state institutions are subject to the engineer's direction and their superintendents must report operation data to him.

6. He exercises the powers and duties of the capitol commission (since July). Construction work on the Capitol is now practically completed but the maintenance of this $7,000,000 building is no small task.

7. The engineering department receives a yearly appropriation of $18,000, out of which is paid the salary of the engineer and architect and other general expenses. All other salaries are charged to the department for which the work in question is done.

While not required by the engineering department statute, the state engineer has been appointed engineer member of the state council of defense, member of the new cement-purchasing board, and member of the board to restore the old territorial capitol at Belmont. In an important new statute which provides for the interchange and coördination of work between different departments, the state engineer is given the initiative in proposing specific plans for such coöperation, and is made a sort of balance wheel between the departments interested.

Dual Control of Engineering Staffs

In this system, the feature which might be expected to cause the most trouble is that whereby assistant engineers are appointed in charge of the engineering work of other departments (for example, the railroad commission), to work under "the general direction of the chief engineer, and the immediate direction of" the department concerned. In practice this plan has worked very smoothly. The former chief engineers of the railroad, tax, and highway commissions have been continued in office, and have continued to direct the engineering functions of these departments, the commission itself in each case deciding all questions of policy. The state chief engineer has strictly limited his supervision to the engineering functions of the various departments, and he has not attempted to advise the latter as to the work which they should give their engineers, or the use which they should make of such work.

Present Organization

The engineering department is organized in six divisions: Railroad and Utilities, Highway, Architectural, Power Plant, Sanitary, and Industrial.

The Railroad and Utilities Division is a continuation, practically without change, of the former joint engineering staff of the railroad and tax commissions. It makes regular yearly valuations of all steam and electric roads and certain other public utilities for the tax commission, and of electric, gas, water, and telephone plants for the railroad commission in rate or municipal purchase cases. There is also a large amount of routine service inspection of gas, electric, and telephone companies, and many special investigations and reports relating to these utilities and to the railroads as w (for example, grade separation). Waterpower devel ments too are supervised by this division, with resp both to valuations and to the design and construction dams.

The Highway Division, also a continuation of existing engineering staff, makes surveys and prepar plans and specifications for and supervises all state-a road and bridge construction and a large part of t county-aid bridge work. Last year about $3,600,0 was spent on 1227 miles of state-aid roads of vario types, and about $540,000 on 352 state-aid bridge This year under the Federal highway law a state-wi system of trunk highways 5000 miles in length is to b outlined.

State Architect

The state architect, the former university architect, has continued in immediate charge of the design of new and remodeled university buildings. He has not tried to supplant the five architectural and two engineering firms which are employed by the state engineer on building projects for the normal schools and various institutions, but has closely supervised their work with notable economies to the state in some instances. Architects are required to turn over their tracings to the state engineer. On all large buildings there is an inspector reporting directly to the state architect and engineer, even where a private architect drew the plans.

The Power Plant Division operates the power plant at the capital and also supervises the operation of plants in 27 educational, penal, and charitable institutions, including purchase of fuel and supplies and keeping of records. It prepares plans for improvements, superintends construction work, investigates and advises on repair work, checks architects' plans for plants in new institutions, and analyzes bids.

Sanitary Division

The Sanitary Division is in charge of the former director of the state hygienic laboratory. It makes sanitary surveys for the State Board of Health, relating mostly to industrial waste and other sewage disposal, stream pollution, and water supply. Since 1913 the board has had a division of plumbing inspection, and it has recently agreed to recognize this as "engineering and architectural," so that the state plumbing inspector becomes a member of the sanitary division of the engineering department.

The Industrial Division conducts the engineering and inspection work of the Industrial Commission, including inspection of factories, tenements, public-assembly buildings and boilers, and fire-prevention work, the last-mentioned having been recently transferred from the insurance department. This division includes an engineer in charge, an illuminating engineer, eight factory inspectors, two building inspectors (engineers), a boiler inspector, and a superintendent of fire prevention who supervises the fire-prevention inspections of local fire departments. The present factory inspectors are not technical men, but as vacancies occur it is planned to appoint only graduate engineers. The problems of present-day industrial safety and sanitation demand the engineering background most of all.

The experience of one state department in engineering and architectural work is usually parallel with and therefore helpful to other departments. One result of the centralization of the state's engineering work is the ease with which transfers of men with special experience may be made to assist the various departments. Many instances of exchange of service have occurred within the two years of the engineering department's existence.

For certain highly specialized professional work, in which only occasional service is required, so that it is not practicable to maintain the required degree of special skill on the regular staff of employees, consulting engineers are employed. Special problems often contain elements of great danger, and for its protection the state should have the aid of the best professional skill in their solution. As occasion has required, the following consulting engineers have been appointed: Mead & Seastone, for consultation on the safety of the Wissota dam, now under construction; W. G. Kirchoffer, for consultation and design on institution sewage, water supply and drainage; F. E. Turneaure, for consultation on stresses in Wells St. viaduct, Milwaukee; H. V. Tennant, consulting engineer in charge of the Portage levee construction.

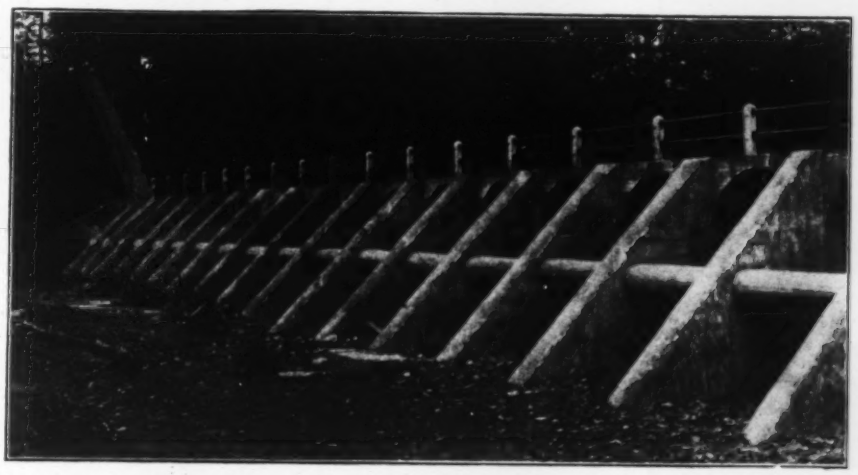
The engineering department has secured greater economy in the design, construction, and maintenance of state buildings. It has helped other departments, which were trying to do engineering work without realizing it, to organize their work on an engineering basis, and thus increase its efficiency. It has not interfered with existing well-organized engineering staffs, but has secured for them a more general recognition of their importance. It has brought about greater coöperation between engineering divisions, and has helped to secure coöperation between non-engineering departments. To important special problems it has brought the services of high-grade consultants, who have given to the state the benefits derived from their experiences and observations.

It has been able to do these things partly because it is an engineering department, but more because it is a department based on merit and free from partisan influences. This, after all, is the key to the engineer's opportunity as a public servant. As an expert pure and simple, his sphere, though important, is limited. But if, when called in as an expert, he can show, slowly and unobtrusively, a capacity to handle delicate and important administrative problems, if he can build up a department whose very efficiency will defend it from partisan attack, then his contribution to the cause of material state improvement and better government will be great indeed. Probably there is no state in the union, in which the engineer could not render similar service to the public.

Drift Catcher at Erie Completed

A REINFORCED-CONCRETE drift catcher, the first unit in the Mill Creek flood-control project at Erie, Penn., has just been completed, as shown in the accompanying view. The purpose of this structure is to intercept drift which comes down the stream during times of high water, and thus to prevent it from blocking the entrance to the tube under construction for the purpose of carrying the flood waters through the City of Erie.

The drift catcher is 18 ft. high and 220 ft. long. It consists essentially of 20 piers spaced 10 ft. c. to c. across the valley. Arches spanning the piers at the top carry a walkway which connects with the concrete stairway leading up the high bank on the west side.



CONCRETE STRUCTURE PREVENTS DRIFT FROM PASSING INTO TIDEWATER CHANNEL

A heavy concrete strut is located near the upstream edges of the piers, about halfway between the base and the top of the structure. Two heavy chains in each bay are hung from this beam and are anchored into the concrete footings at the upstream edge, these chains being for the purpose of intercepting small drift which would otherwise find its way to the openings between the piers.

The construction of the flood protection work in Erie is under the supervision of Gannett, Seelye & Fleming, consulting engineers, of Harrisburg, Penn. The details of the drift catcher were shown in a drawing in *Engineering News* of Oct. 26, 1916.

Lumber Cut Lags Behind Shipments

Because of strikes and other unsettled conditions, the lumber production of the country in August was 18.5% less than in the same month last year. Shipments, however, were 6.6% greater, because of the heavy demand for building material by the government and for factory construction. During the eight months ended Aug. 31 the 701 mills reporting to the National Lumber Manufacturers' Association cut 2.7% less than in the same months in 1916, but they shipped 7.5% more. The total production of lumber of all kinds will be, according to estimates made recently, 38,000,000,000 feet in the current year.

Good Workmanship Necessary To Make Sea-Water Concrete Safe

Correct Proportions, Judicious Use of Water, Tight Forms, a Good Contractor and Efficient Inspection Are Needed To Bring Concrete to Proper Condition To Resist Sea-Water Action

By Rudolph J. Wig and Lewis R. Ferguson

Last of Five Articles on the Problem of Sea-Water Concrete, Written As a Result of an Investigation and Inspection of Practically All the Marine Concrete Structures in the United States.

THE CHARACTER of the workmanship has an important bearing on the ability of concrete to resist the action of sea water. Only contractors of experience, employing competent men, should be intrusted with important work in sea water, where the difficulties usually encountered cannot be overcome by any but the best of organizations thoroughly equipped with the necessary tools and machinery. Letting of work to the lowest bidder usually proves a costly procedure.

Extreme Care Necessary in Building

No matter how carefully the structure is designed, careless methods used in construction will cause trouble. Unfortunately, imperfections cannot be detected at once, and frequently patches and a wash of cement grout over the surface hide for a little while defects which ultimately result in failure.

But the defects due to workmanship cannot always be attributed to carelessness. Engineers have employed methods which they believed would produce superior results but which as a matter of fact frequently caused failure. The necessity for extra care in building concrete structures subjected to sea-water action has not been appreciated. As a rule engineers have followed common practice and permitted about the same quality of work in their sea-water structures as they secure for those on land.

This must be changed if the trouble now so prevalent with concrete in sea water is to be overcome. It is not only necessary to erect better concrete structures in sea water than on land, but this must be done in the face of increased difficulties. Engineers must provide more rigid and intelligent inspectors, in whom are placed implicit confidence, and they must insist upon the contractor following instructions. And when controversies arise the engineer must support the inspector—but these requirements must be made plain in the specifications, so that misunderstandings will be avoided and all will work in harmony, for only by so doing will the best results be secured.

Minor Defects Cause Trouble

The necessity for extreme caution in every detail of the erection of a concrete structure in sea water cannot be too strongly emphasized. Even what would be considered very minor defects in a land structure must be avoided in sea-water work, for these defects are points of weakness which are readily attacked, and disintegration once started spreads to adjoining sections, causing failure.

The experience gained in one very large project which included several thousand pier structures is interesting in this connection, as it shows how greatly the quality of concrete in sea water can be improved by the exercise of extreme care. The piers were built in forms sealed at the bottom with concrete deposited through a tremie. This seal acted as the footing for the piers, and after it had set the water was pumped out of the forms, and the balance of the pier was constructed in the dry.

In the first work, embracing more than two hundred structures, which was done in accordance with usual methods, more than 50% of the footings were found to be seriously defective. When this condition was discovered, the necessity of using far more care was seen, and a marked improvement in the character of the workmanship was insisted upon for the next several hundred structures. The result was that only about 1% of these piers had any defects. The engineers were not yet satisfied and insisted upon even more attention to details, and as a result the last several hundred piers have shown practically no defects whatever.

According to the reports of inspection, the defects were caused by improper use of the tremie, by leakage of the forms at the bottom edge, by lack of thoroughness in the removal of sand which had washed into the forms before the concrete was deposited, by lack of care in thoroughly cleaning the surface of the old concrete when resealing was necessary, and in some cases by the breaking of corners in the removing of forms.

The defects in the piers have been repaired, the same care being used as in the recent work, and now they are all in good condition.

General Principles to Be Followed

The methods to be followed in sea-water concrete work depend in certain details upon the location of the structure, as this governs the rigor of the climatic and sea action, and also upon the particular design employed, this too being governed considerably by the conditions to which the structure will be subjected. Certain general principles can be followed, however.

The forms should always be made tight, so that leakage of the concrete will be prevented. For work below the low-water line this is just as true as for that above. The best under-water work is secured by erecting a cofferdam and building in the dry, but this is expensive and at times impossible. When the bottom of the work is at a depth below water which prevents its being seen from the surface, the services of a diver

are essential, for the forms must be carefully examined to insure their tightness. Leakage is most likely to occur around the bottom edge of the forms where they rest on the ground. In such cases the washing of the tide carries away the mortar from the concrete, leaving honeycombed sections which are readily cut away as soon as the forms are removed. This undermines the supporting parts of the structure, and settlement and cracking result. A very simple and effective method of preventing the trouble is to plug the crevices around the bottom edge of the forms with bags filled with sand, or better still, bags of concrete.

A popular form of construction where limnoria and teredo are not found is that of wood piles cut off at or near the low-water line and supporting a wood platform on which rests a gravity-section concrete wall. Where this type of structure has been used it is not unusual to find the lower outside edge disintegrated. This is due largely to the fact that the joint between the face form and the platform on which the wall rested was not made tight. The bottom layer of concrete is deposited when the tide drops to the lowest point. This, however, is frequently but little below the platform, and so the water rises to that elevation shortly after the concrete has been placed. If there is any leakage along the bottom edge of the front form the fresh, soft concrete is very likely to have the mortar washed from it along this section. This results in a porous mass which is readily attacked.

The bottom joint, however, is not the only one which should be tight. They should all be tight. It is advisable to use lumber surfaced on the edges and inside face; and in some instances where the wash of water is severe, tongued and grooved material should be used. Smoothness of the exposed face of the concrete assists materially in resisting sea-water attack, and this cannot be secured unless forms are carefully made of surfaced lumber.

If the forms are oiled, and this is preferable, a mineral oil should be used. Practically any kind of mineral oil is suitable, and cylinder oil has been much employed. Two or three applications of kerosene serve better than cylinder oil in preventing the sticking of concrete, and this has the added advantage of not staining.

The forms for the concrete wall of a Canadian wharf were coated with fish oil. This caused a soft pitted and chalky surface which is porous and easily abraded. Very soon after the removal of the forms places were observed where the fish oil had disintegrated the concrete. See Fig. 1.

FIG. 1. FISH OIL ON THE FORMS CAUSED SOFTENING OF CONCRETE SURFACE

Correct Proportions Important

After the materials are selected the concrete must be proportioned to secure the maximum density. Density and strength are closely related and generally the concrete with the greatest density will possess the most strength—that is, when made from given ingredients.

Proportioning by means of void measurement is not satisfactory, nor is a mixture based upon granulometric measurement. The best method of arriving at the proper proportions is actually to mix the cement, sand, and stone together with the amount of water to be used and by trial determine which mixture produces the minimum resulting volume from given amounts of the ingredients, measured separately. This subject is discussed at length in Technologic Paper 58 of the Bureau of Standards, and in many other technical articles.

The stronger and tougher the concrete the less likely it is to be chipped and abraded, with the consequent exposure of the interior of the mass to chemical attack. The denser and more compact the concrete the less will be the absorption of moisture, and with the diminishing of the absorption the possibility of initial disintegration from frost action will be materially lessened. The present almost universal method of arbitrarily specifying the proportions of the concrete is not scientific and in most cases does not produce the best grade of concrete from given ingredients. Far more care than has previously been used must be exercised in determining the best proportions, and then there must be insistence that the proportions determined upon are rigidly adhered to by the contractor.

Generally it is advisable to use richer mixtures than would be used for similar structures on land. The sand or stone will vary somewhat, even though it comes from the same source, and so it may be necessary to vary slightly the proportions as the work proceeds. In order to secure continuously the best grade of concrete the engineer should make tests at frequent intervals, not only of the ingredients of the concrete, but also of the concrete itself as mixed by the contractor.

A city on the Pacific coast which has been spending millions of dollars in improving its harbor facilities and building large concrete docks maintains a well equipped laboratory exclusively for this work. Here tests are made daily to determine the quality of concrete the contractors are producing and also to keep a constant check upon the aggregates being supplied. In this laboratory the proportions for the concrete are determined, and as it becomes necessary these are varied from time to time. The inspectors on the work are given power to insist that these directions be explicitly followed.

The amount of water used in mixing is of even greater importance, perhaps, than the proportioning of the concrete. This is particularly true for sea-water work. If too little water is used the concrete is porous and the surface lacks smoothness and density; if too much is used the concrete is also porous and the surface chalky and weak. The proper consistency is one just dry enough to permit of *light tamping* but not so dry as to require any effort to bring water to the surface. This

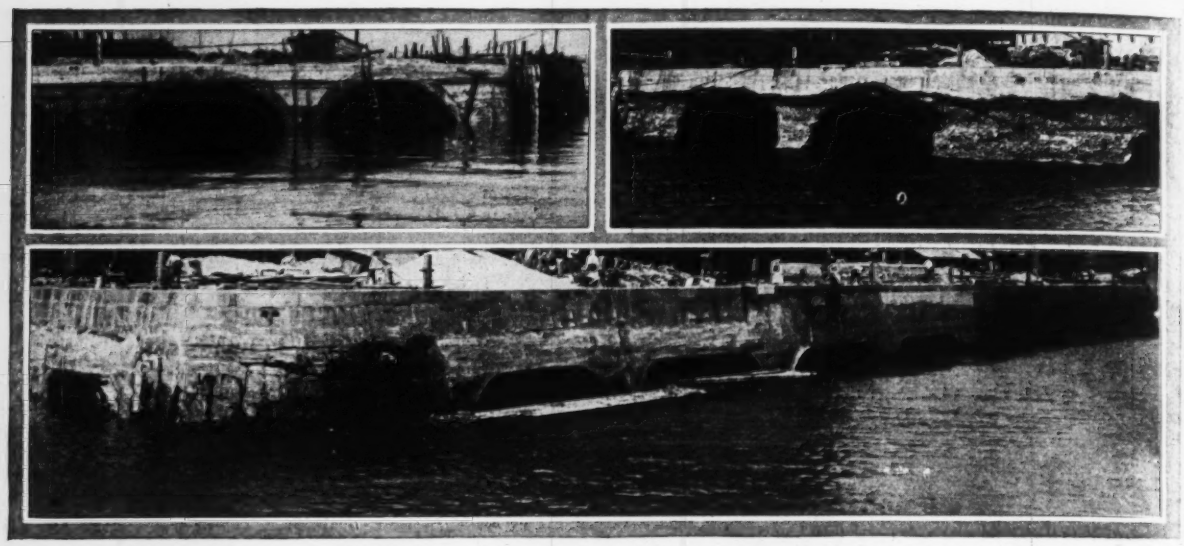


FIG. 2. HOW CONSISTENCY AFFECTED THE WEAR OF ONE CONCRETE PIER

Upper left-hand view is outboard end of pier made with dry concrete just after completion. Upper right-hand view shows same section eight years later. The lower view shows excellent condition of medium consistency concrete at right in comparison with wet consistency at left

is hardly wet enough to use for reinforced work, and for this class of construction a little wetter consistency must be used; but a very slight addition in the amount of water used in the mixing will produce a marked effect. The influence upon the strength and porosity of the concrete exerted by varying the amounts of water used in mixing has been emphatically demonstrated in recent publications. The use of excess water may decrease the strength 50% and greatly increase the porosity and friability.

The effect of the consistency employed on the ability of the concrete to resist sea-water action was forcibly emphasized in many instances during the examination made by the writers.

There is a pier on the New England coast which illustrates this excellently. This pier was built under two contracts, the outboard section being completed first, after which the inboard section was begun by another contractor. The designs for both sections were exactly the same and the ingredients used in the concrete were identical. There is practically no difference in the exposure condition. The outboard section was constructed under the direction of an engineer who believed thoroughly in dry concrete, as did most engineers at that time. Even before this section was completed there were evidences of disintegration in some parts of the work as shown in one view in Fig. 2. The condition of the same wall 8 years later is shown in another.

About the time the inboard section was started another engineer was put in charge of the work. He decided to allow a little more water to be used, though not so much that tamping could be dispensed with. The inspectors stated, however, that very little tamping was sufficient to settle the concrete into the forms. The conditions of exposure to which this pier is subjected are severe, but in spite of the fact that there is no adequate fender system, the inboard section is in excellent condition after 15 years of use, while the outboard end continued to disintegrate to such an extent that about five years ago extensive repairs became necessary to prevent collapse of parts of the structure. When these repairs were made the wets were in power and a sloppy consistency was considered the proper thing for all concrete work. The engineer in charge of the repairs used a very wet mixture, partly on account of the fact that the work was reinforced. This concrete has also disintegrated to a considerable extent and is at present in much worse condition than the inboard section of the pier, on which no repairs whatever were made.

Here we have three specimens of concrete of similar ingredients, exposed to the same conditions, the only variable being the amount of water used in mixing. The very dry and the very wet concrete have been decidedly unsatisfactory. That of a medium consistency has successfully resisted disintegration under very severe exposure.

In another harbor along the North Atlantic coast are several miles of concrete quay walls, built during the past twenty years. Some of them were erected while engineering practice dictated that a minimum amount of water should be used in mixing the concrete; some were built during the transition period when the amount of water was being increased, and those constructed since about 1905, especially those built recently, were of a much wetter consistency. All of these walls are of the same design and materials of the same quality were used throughout the work. The exposure conditions are practically the same in all parts of the harbor. All of the walls built prior to 1900, when dry mixed concrete was used, have disintegrated to such an extent that they have had to be frequently repaired and several sections entirely rebuilt. Those erected since 1905 of wet concrete with few exceptions have also been replaced on account of deterioration, or have needed a considerable amount of maintenance, but those built between 1900 and 1905, or during the time the concrete was made of a medium consistency, have needed no repairs at all and are found to be in excellent condition at present.

It is evident that the amount of water used in mixing concrete exposed to sea water action has a most important bearing upon the durability of the structure. *Either too dry or too wet a consistency will cause failure.* A medium consistency must be used if permanency is to be secured under severe exposure conditions.

The effect of thoroughness of mixing upon the quality of the concrete warrants more consideration by engineers, especially those engaged in designing sea-water structures. Any expedient which makes for better concrete should be seized upon, for only the very best material can successfully resist the rigorous conditions to which structures in sea water are exposed. Up to a certain point there is a rapid and consistent increase in the strength of concrete with the thoroughness of mixing. The amount required to give the best results is dependent upon the conditions, such as type of mixer, proportions, consistency and character of materials.

Perhaps this phase of the subject will be made more impressive if put in this way. A better quality of concrete at less cost can be secured by omitting a considerable part of the cement and increasing the thoroughness of mixing.

Concrete Must Be Properly Placed

After the concrete is mixed comes the placing it in the forms. In this, especially, more difficulties are encountered in sea-water work than in land structures, and yet only the best quality of work will be permanent.

Unless a cofferdam is built and the concrete placed in the dry, either a tremie or a bottom-dump bucket is used. Both methods have proved successful, although the tremie is preferable if correctly operated. This, however, is far from a simple thing to do. Contrary to the supposition of many engineers, the concrete cannot be forced up above the bottom edge of the tremie for more than a few inches, even when the pipe is long and kept full. In order to start the flow the bottom of the tremie must be raised slightly so that the lateral movement of the concrete restrained by friction is permitted. As soon as the concrete starts to move it tends to discharge rapidly, owing to the combined hydrostatic and velocity head, and this frequently results in the loss of the charge—for a very nice balance must be maintained in order to control the rapidity with which the concrete leaves the pipe.

Of course a tremie should always be plugged when first charged; otherwise a layer of separated stone, sand and cement mixed with laitance will be deposited in the bottom of the forms, or a seam of such material made in the structure.

The bottom-dump bucket method possesses the disadvantage of permitting at least a slight settlement of the concrete through water and the precipitation of a small amount of magnesia on the surface of each batch. This will cause some laitance to permeate the mass, and may also cause some segregation. As with the tremie, successful results can be obtained only by the exercise of extreme care.

If the work below the low-water line is carried on intermittently trouble may occur unless particular precautions are observed thoroughly to clean the surface of the concrete previously deposited before the placing of concrete is resumed. This is what happened in a large pivot pier along the middle Atlantic coast. The depth of water in which the pier was built is about 45 ft., and the pier is 18 ft. in diameter.

It was intended to construct a cofferdam and place the concrete in the dry. Leakage through the bottom and sides caused this plan to be abandoned, and the concrete was deposited in the water by means of bottom-dump buckets. The work was carried on only during the daytime. Upon resumption of concreting in the morning no care was taken to clean off the surface of the concrete placed the day before; in fact, the necessity for this was not even thought of. Of course the water covered it, and it was taken for granted a good joint would be secured between the days' work.

The cofferdam was left in place and it was not until a number of years after the work was completed that any apprehension was felt by the engineers as to the stability of the structure. By that time the planking of the cofferdam had rotted and enough of the boards had fallen away to expose a considerable section of the concrete. Only the part between high and low water

FIG. 3. RIVETED IRON SHELLS FORCED OPEN BY FREEZING OF MOISTURE IN SOFT MATERIAL

could be seen. Here, however, the concrete had the appearance of a layer cake, with the soft material between the layers cut out to a considerable depth.

In order to determine the real condition vertical holes were drilled through a considerable depth of the pier. For about 6 in. the drilling was hard, then a soft section was struck, then a foot or so of hard material, then another layer of soft, and this continued to the bottom of the drilling. The soft sections were of varying thicknesses, some being as much as 24 in., while others were only about 6 in. thick. It was quite evident that these layers were formed between successive days' work. This pier is now in a serious condition and means will have to be taken soon to prevent failure.

A somewhat similar cause is responsible for a peculiar condition discovered in the supporting columns of a pleasure pier. In this case 18-in. riveted steel shells used as forms were sunk to the required depth, and the sand was pumped out. Water leaked in through the bottom, partly filling the shells, and concrete was deposited through this water. Here, however, the work was carried on continuously until the concrete was brought up to the elevation of high water—the shells being of sufficient length to reach to the deck. After the concrete reached the high-water line the forms for the beams and deck were built and concreting continued.

As the deck was about 15 ft. above high water the supporting columns had to be extended this much.

No effort was made to clean off the surface of the concrete previously placed in the shells before the upper section was deposited. After the pier had gone through the winter an interesting condition was discovered in the supporting columns. It appeared as though the rivets in each shell for a distance of from one to two feet near the elevation of high water had been cut out and the shell pried open at the joint. Some of these shells are shown in Fig. 3. This exhibited a cavity in the column which in some cases was as large as a man's head. Instead of concrete a soft chalky material was found. This had come to the surface as the shells were being filled to high water, and then it was covered when the filling of the section above the high-water line was completed. During the winter the moisture in this soft layer had frozen and burst the shells and as soon as the steel protection was removed the waves washed out the soft material. Since then chemical disintegration of the concrete has progressed until many of the columns have failed completely and have had to be renewed.

Construction Seams Must Be Prevented

For the work above the low-water line every precaution should be taken to prevent the formation of construction seams of laitance. If the tide rises and covers the section before completion of the work the surface of the concrete should be thoroughly cleaned by scrubbing with a stiff broom and washing with a hose before resumption of concreting.

In a harbor on the Pacific coast was found an interesting illustration of the value of extra precautions in this respect. Here there are a number of concrete sea walls built at different times but of similar design and materials. Although the specifications called for thorough cleaning of the surface of the concrete at construction joints, it was evident, this was frequently not as carefully attended to as it might have been, for thin horizontal seams could be seen. (This is a criticism which applies to most of the concrete sea-water structures along our coasts, for almost always the place where work was stopped due to the rising tide is conspicuous.) In one section of the walls just referred to, however, no construction seams could be found. The inspector who had been in charge during construction explained the reason for this. The contractor had covered the concrete with a canvas held in place with heavy weights whenever he had to stop concreting, so that a clean surface was found when the tide receded.

The simplest way to prevent disintegration at construction seams is to not have any such seams. If the work is done in short sections bulkheaded between the forms the concrete can be brought up faster than the tide rises.

While the concrete is being deposited it should be compacted so that the densest condition possible will be secured. If the proper consistency is used it will permit of light tamping, and under this treatment the concrete will quake and settle into a very compact mass, free from pockets and void spaces. The concrete next to the forms should be spaded so that a dense smooth surface will be secured, such a surface when exposed offering the greatest protection against the disintegrating action of the sea water. If it is firm, strong and tough, chipping and abrasion will be greatly lessened and the possibility of deterioration of the structure decreased.

Under many conditions a mortar face richer than the body of the structure will prove economical; and where local materials are not of the highest quality this mortar surfacing can be made of imported aggregate of good quality, which if properly applied will protect the interior concrete made of poorer material.

It is impossible to apply a mortar coating to concrete after the forms are removed and have it adhere to that part of the structure below the high-water line, and it

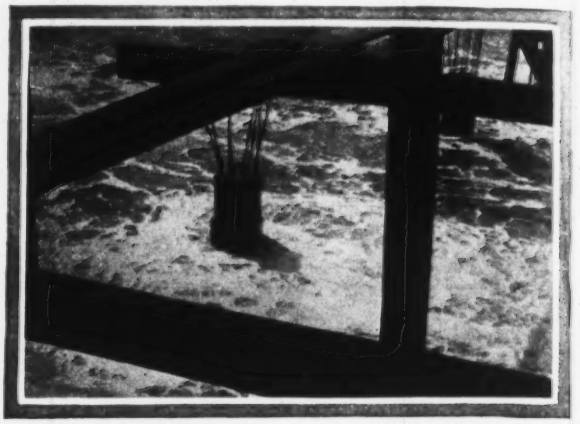


FIG. 4. LEAVING A JOINT SUCH AS TO BE MADE ON PILE IN CENTER OF VIEW MAKES WEAK SECTION

is between the elevations of high and low water that it is needed far more than anywhere else.

Many structures may be most economically built by using precast members. The concrete can be prepared and placed under far less difficulties, and it can be allowed to harden and cure thoroughly before being acted upon by sea water. But in precast work as well as work deposited in place, porous concrete, rough surfaces, leaky forms, and seams and joints will cause deterioration.

The practice of making precast piles of such length that a joint must be made between the elevation of high and low water, as shown in Fig. 4, should be discontinued. Often precast piles are found to be too short and have to be extended after they are driven. It is almost impossible by present methods to make a satisfactory joint between the elevation of high and low water. However, if a joint must be made at this elevation the utmost care must be exercised to clean the top of the pile before the concrete for the extension is deposited, and no leakage of the forms can be permitted if disintegration is to be prevented. The numerous structures which are showing signs of trouble at these construction joints give evidence that the need for the utmost care was not appreciated.

Deterioration of concrete structures in sea water is progressing in many places along all our sea coasts. When within a few years, or even months, a concrete structure costing hundreds of thousands of dollars shows marked signs of disintegration just because the necessary care was not exercised in its construction it is time to sound a note of warning. Concrete can be used successfully in sea water, but the price of success is eternal care.

Specially Ruled Sheets Have Wide Use in Drafting Room

Printed from Wax Plates, Little Trouble Is Experienced with Shrinkage—Not Adaptable to Large Structures

By Richard T. Dana
Consulting Engineer, New York City

THE USE of a standard cross-section paper for the plotting of curves which were to be blueprinted was found to be so convenient for other uses that in the writer's office it has practically supplanted other methods, except for maps and plans of large structures on which many of the details, such as rivet spacing, etc., require the use of extensive sheets. The success obtained resulted in the development of a set of methods employing a specially ruled paper for nearly all of the work for which, previously, the ordinary kind of tracing cloth, cross-section sheets and profile rolls have been employed.

The principal objections to the use of tracing cloth are that it turns opaque with age, and stretches unequally in various directions. Sometimes this stretching is considerable, and will vary with the weather. Furthermore it is ruined by water, so that if left by an open window, in a damp atmosphere, or over a radiator from which the steam is escaping, an expensive drawing may easily be spoiled.

Nor can it be satisfactorily used in a typewriter. Since it is easily cracked, it cannot be folded without injury, and hence is not conveniently portable. The small red ants, which infest the foundations and walls of buildings in hot climates, eat holes in the paper in endeavoring to get the sizing. Where these ants are present it is not safe to leave a tracing on the drawing table overnight.

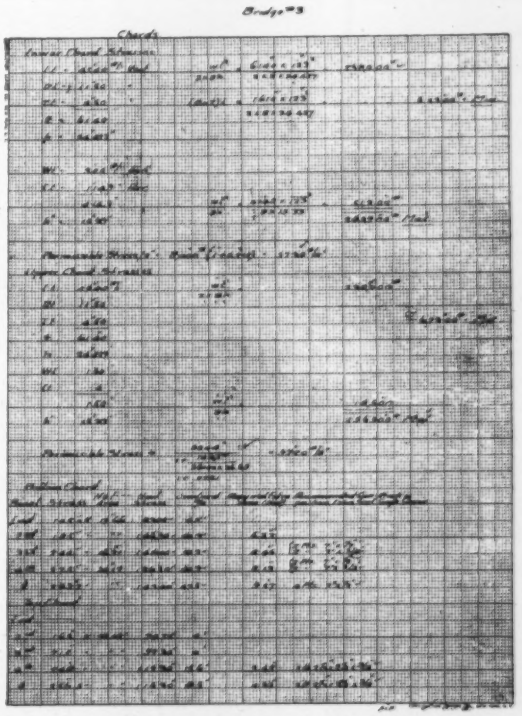
Another objection to the usual systems lies in the fact that small tracings are of a good many different sizes, and are difficult to file satisfactorily. They must be kept flat and, when filed in large envelopes or folded in a sheet of heavy paper, are not readily at hand when wanted. They often become turned around in the drawer, the title of the desired sheet is seldom where one expects to find it; and consequently a certain amount of time is lost.

Ordinary Cross-Section Paper Is Faulty

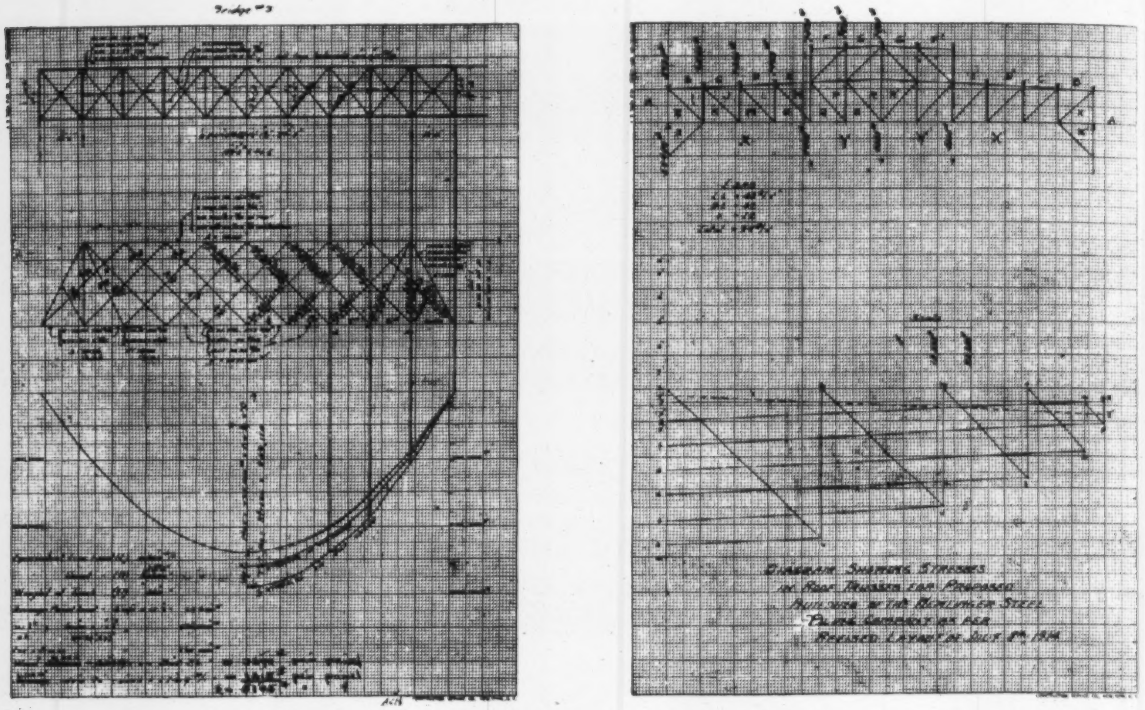
The ordinary cross-section sheets which are ruled to tenths of an inch have been found to have the following objections: (1) The paper is so thick that they cannot be satisfactorily blueprinted. (2) They are of an inconvenient size—too large for the letter file and too small for the map file. (3) They are too stiff to lie flat and are constantly curling. (4) The ruling is not convenient for the listing of tabular data on the same sheet with the cross-sections, the lines being so close together ($\frac{1}{10}$ in.) as to offer no guide for any but the smallest figures, whereas the inch lines are either too near together or too far apart to be used as column rulings. (5) The sheets cannot be satisfactorily folded on account of their thickness and stiffness, and when rolled for the sake of portability they acquire the rolling habit and object to lying flat ever after. (6) The use of a scale of 10 ft. = 1 in. for plotting cross-sections is not satisfactory, since the eye does not accurately interpolate between the $\frac{1}{10}$-in. lines; consequently the plotting is actually accurate to the nearest $\frac{1}{20}$-in., ordinarily representing $\frac{2}{10}$ of a foot. The same degree of accuracy in plotting can be accomplished on a paper ruled to about half this scale.

Nor Will Profile Paper Answer

In the case of profile paper we found that for most purposes there were the following objections: (1) It cannot be blueprinted unless tissue papers are used, and these are easily destroyed by careless handling, or even by heavy gusts of wind when they are not properly tacked down to the drawing paper. (2) It does not take erasure well. (3) The horizontal spacing of the heavy lines (4 in.) is inconveniently great for the plotting of 100 ft. stations, and the $\frac{1}{10}$-in. space is a little too small for the same purpose where two or more pluses must be entered between two 100-ft. stations. The approximate location of the pluses cannot be marked closer than to the nearest 10 or 15 ft. except with the use of a scale, which involves a serious waste of time. (4) The vertical spacing is usually not convenient, the heavy lines indicating feet or 10 ft., etc., and the light ones feet, or $\frac{1}{5}$ ft. To obtain greater precision than $\frac{1}{10}$ ft., a scale of 1 ft. per in. must be used, involving a value for the smallest space of $\frac{1}{25}$ ft., which is neither necessary nor convenient. (5) The profiles when rolled up are most inconvenient to carry about, and they occupy a very large space in the files, due largely to their shape. (6) In making use of them much time is lost, rolling them back from end to end to find the point wanted where the profiles cover a considerable length of line.



CAN BE USED IN COMPUTING AND TABULATING



A PRECISION OF ⅛ OF 1 PER CENT. IS POSSIBLE OF ATTAINMENT

The inconveniences mentioned before came to mind with such monotonous regularity that after a number of years it was decided to experiment with sheets of paper 8½ in. wide by 11 in. long—the size of a standard letter head—punched in the left-hand margin for filing in a loose-leaf book, and ruled to $\frac{1}{20}$-in. with every fifth line heavy and every tenth line extra heavy.

For various reasons it was necessary that the ruling be as accurate as possible without making the cost of the paper prohibitive. Lithographed rulings were tried but it was found that in the process of printing from the stone the paper absorbed considerable water and shrank very decidedly in drying out. Moreover, in common with tracing cloth the shrinkage was not uniform in all directions, and the resultant error, while not a fatal defect, was nevertheless inconvenient for those operations involving the use of a scale upon the paper. The plan adopted was to rule a plate on wax with a dividing engine, the probable error of which was less than 0.001 in., or ¼ of the thickness of the fine lines on the plate. The plate itself measures 7½ in. by 10 in., which allows sufficient leeway on the paper for marginal notes and for binding. For convenience of handling the paper was made up into pads of 100 sheets each.

At first a bright red ink was used on the theory that this would blueprint better than other colors, but experiment showed that an olive green was much less fatiguing to the eye while working on the paper and gave entirely satisfactory prints. With the proper quality and thickness of paper it was found that pencil marks were readily transmitted to a blueprint. In this manner copies of pencil sketches were obtainable which were sufficiently legible for all practical purposes.

The paper when printed and after having been stored a number of months in the office and becoming thoroughly dried out is apt to show a slight shrinkage amounting generally to something less than $\frac{2}{10}$ of 1%. For our purposes this has never been enough to make it worth while to eliminate it, but it could probably be entirely removed by having the paper stored for several months before printing. Whatever shrinkage takes place seems to be nearly uniform, so that diagrams made on the paper appear in their true proportions.

In making detail sketches dimensions are furnished by the lines on the paper instead of by drawing lines and marking out points with a scale as when sketching on blank sheets. Sketches can be made in this manner very much more rapidly, and with the same degree of accuracy, as in the old way.

Good Paper Makes Record Permanent

The record thus made on a durable grade of paper is as nearly permanent as anything of this sort can be. It will probably be as fresh and clear and legible fifty years hence as the day after it was made. The sheets may be filed in a standard letter file with the papers belonging to their particular piece of work, or they may be filed in loose-leaf books or bound in permanent form with special binders. All these methods have been used interchangeably.

For use as cross-section paper these sheets, containing an area of 30,000 sq.ft. on a $\frac{1}{20}$th scale, are sufficiently accurate for most purposes, and can be plotted to the nearest 0.2 ft.

For surveys involving a very large number of sections it has been suggested that blueprints from these sheets on thick paper be used, determining the areas by cutting out the sections and weighing each on a chemical balance. Cross-section paper is sometimes objected to for plotting sections which are to be plani-

tered, as its shrinkage necessitates a planimeter setting that is difficult to determine. Where the weighing method is employed shrinkage is of no importance as the section is to be compared by weight to a unit section which has shrunk uniformly.

For use as profile paper these plates have been entirely satisfactory, each sheet running for 20 stations horizontally and for 150 vertically to an accuracy of 0.2 ft. or 15 ft. vertically with an accuracy of 0.02 ft. When so used it has the advantage that mass diagrams and cross-sections can be placed on the same sheet, together with the tabular data accompanying the latter.

This paper has been used a great deal for progress diagrams, for which a 31-day month may be listed the short way of the paper, reading vertically when these sheets are filed in a loose-leaf book, and allowing a range for plotting of from 0 to 20 or any multiple thereof.

The original purpose for which the paper was designed was the plotting of curves, and for this the $\frac{1}{10}$-in. ruling has turned out to be very well adapted, since across the paper it runs from 0 to 150 and lengthwise from 0 to 200, thus giving a range sufficiently great for almost any kind of work.

Stress Diagrams and Equilibrium Polygons

One of the most convenient uses of the paper, and perhaps the last one which ordinarily would suggest itself, is for stress diagrams and equilibrium polygons in graphical statics. It would appear that small diagrams on this paper could not be made to sufficiently great precision to give a satisfactory check, but experience with it has shown that this is not the case. If the points are set with care, and the parallel lines ruled with a pair of small but accurate triangles and a wedge-pointed pencil, the resultant precision of the work is remarkable. It is entirely possible to obtain results within $\frac{1}{2}$ of 1%, which is satisfactory for most purposes. Very long lines on tracing cloth will be found not to be as accurate as they appear.

A convenient size of the equilibrium polygon is half the length of the paper or 1000 divisions. Working to one-fifth of one division for half of this length gives an average error of one in five thousand. This is very much smaller than the error in the setting of the rolls for the manufacture of structural steel shapes, and therefore any greater degree of refinement than this is a bit ridiculous.

The paper is used very largely in computing and tabulating figures, as will be noted by reference to the three plates accompanying this article which have been taken more or less at random from the files of this office. It is often convenient to typewrite titles and notes on this paper rather than taking the trouble to letter them on freehand. When this is done, a piece of carbon paper placed underneath the section paper with the carbon side up will so strengthen the imprint of the type that most excellent blueprints are obtained.

A curious feature of this paper is that it can be used as a protractor, and is more accurate than the ordinary paper protractors on the market. A great many other uses for this paper will suggest themselves to men in the various branches of engineering, but the above are given as suggestions and have been taken from actual experience in the use of the paper. About a year ago we turned the idea over to a publishing company which has placed it on the market, and I am informed that it is coming into extensive use.

The principal objection to the paper is its lack of adaptability for very much erasing. Pencil marks can be erased without difficulty or injury to the ruling, and ink lines may be taken out by the use of a sharp knife and a moderate rubbing with a medium rough eraser. Any heavy general erasing of the ink lines, however, is destructive to the ruling.

Convict Labor and Patrol System for Texas Roads

IMPROVED road maintenance organization for Dallas County, Texas, is recommended by J. F. Witt, county engineer, in a report based on an extended visit of inspection to central and eastern states. The county has about 600 miles of surfaced roads and 800 miles of earth roads, with an annual income of $200,000 from the road and bridge tax. It is divided into four districts, each having a commissioner.

By Mr. Witt's plan, in each district the 200 miles of earth road would be maintained by convict labor and new construction would depend upon the time that could be spared from maintenance work. It is thought that this restriction of the opening up of new roads would be offset by the extra attention given to the existing roads. The annual cost of the camp and of the bridge, timber and road machinery for the maintenance work would be $11,500. The remaining $38,500 for maintaining 150 miles of surfaced road would be allotted as $600 per mile for 25 miles; $300 per miles for 25 miles and $160 per mile for 100 miles.

There should be a general superintendent of maintenance at $1800 per year, of which each district would pay $450. He would spend most of his time traveling the roads and would report to the Commissioners' Court. He would have authority over the road gangs of the districts. In this way the work of the entire county would be standardized. Each district would have its supervisor and district gang of eight teams and drivers, as at present. These gangs would fill the bins with stone and gravel, and also distribute the material at the road side, for the use of the road keepers or patrol men. They would also patrol and repair 50 miles of the roads having the lightest traffic, to which no road keepers are assigned.

Road Patrol System Advised

These road keepers constitute an important feature of the proposed system. There would be twelve to each district, with 5 miles per man on the heavy traffic roads near the city, 8$\frac{1}{3}$ miles on the roads of next importance, and 12$\frac{1}{2}$ miles per man on the roads with light traffic. With material for patching and surfacing placed at convenient points along the road, the keeper would be on the road all the time, to keep it in good condition. He would have a team available for use with a grader or drag when necessary.

The road keeper should be identified to the traveling public. For this purpose Mr. Witt suggests that the man should wear a cap or hat of distinctive type and color. He should have also a flag or marker of the same color, to be displayed at the roadside when he

leaves the road at any time. This marker would indicate the road-keeper's location to the general superintendent when on his rounds.

One motor truck and trailer would serve the entire county and is considered essential for long hauls. This outfit would cost $5000, or $1250 for each district. It is recommended that all road building material be purchased by the Commissioners' Court, in sufficient quantity to insure good prices and on the basis of competi tive bids when possible.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

How One Engineer Feels About the Civil Service Examinations

Sir—I have gained the impression that practically all appointing officers try to evade the civil service rules and often from exactly opposite motives. At one end of the scale is the engineer of ability who resents any attempt at dictation as to the men he shall employ; at the other end, the politician who wishes to appoint friends incapable of passing the examinations. It seems as if something is fundamentally wrong with a system where such a situation exists, even though engineers at least openly defend the system and may at times find it of value as a protection against political pressure where a large number of appointments are to be made.

Personally I have always felt that a man was justified in feeling resentment at the necessity of passing a civil service examination when he considered himself a person of fair intelligence and education whose record was open and could be ascertained from outside sources by any appointing office.

I have known a number of men whose subsequent record has shown them among the best engineers who have flatly refused to consider a position when they were required to take an examination.

Boston. CIVIL ENGINEER.

Macadam Roads in War Zone

Sir—As a road official in charge of the construction and maintenance of macadam highways, I have read with great interest W. J. Weir's article on "Road Maintenance in the War Zone of France," in *Engineering News-Record* of Sept. 13, p. 488, your editorial of the same date and the letters to the Editor in subsequent issues.

One factor that seems to have been overlooked in the discussion is the "flexibility" of the macadam road—in other words, a macadam road will carry any amount of traffic that could come upon it, provided the surface has constant attention. Had the French roads been surfaced with "permanent" material before the war, I doubt that the engineers in charge could have foreseen the present demands of war traffic. The width of metal and the foundation depth may be readily increased on a macadam road without interrupting traffic.

As for the actual maintenance of a macadam road under this traffic, it has no doubt required thousands of men, but I understand that this work has been done largely by prisoners and men unfit for military service. The maintenance of a system of macadam roads in peace time would show very likely a small cost per mile for the entire system. Had France depended on a few "permanent" roads it is doubtful if the famous "taxi-cab dash to the Marne" would have been possible.

It seems to me, therefore, that the conclusion in your editorial note, Sept. 13, p. 481, that macadam lends itself to the emergencies of war best of all types of hard roads is correct, but it does not follow that macadam is the best road. War simply demands a reversion to the simpler types of construction, as for instance the corduroy and plank roads now being built by the French engineers in Flanders, which are practically identical with the first "pikes" through the swamps of this state.

R. L. LONGSHORE,

Decatur, Ind. Deputy Engineer of Adams County.

Sir—The writer was very much interested in the article "Road Maintenance in the War Zone of France," by William J. Weir, in *Engineering News-Record*, Sept. 13, p. 488. Mr. Weir seems to think that the water-bound macadam road, the prevalent type in northern France, is the only type of pavement that could be used successfully under the conditions prevailing in that section. He states:

"One is inclined to wonder what would happen to our bituminous concrete, or to our brick construction if these were subjected to the continuous pounding of traffic, such as occurs, for instance, on the Anicus Road. They would develop severe weakness, of course; no standard surface would withstand such wear. I believe that the difficulties in repairing them in kind, would be enormous owing to the absolute lack of time for necessary refinements. Modern war traffic over our standard country highways would undoubtedly bring serious problems of maintenance and repair."

Mr. Weir also makes the following statement:

"The Bar-le-Duc-Verdun road, about 50 miles in length, had carried, during the months of the attack on Verdun, a continuous chain of about 5000 motor trucks night and day. The total wear and depreciation of the surface must have been terrific."

After a careful study of Mr. Weir's article it is my conclusion that the water-bound type of highway in the war zone has to be resurfaced or renewed continually, and is not subject to what one may term strict maintenance and repair. This seems to be borne out by his further statement:

"When, and as soon as, the shifting of the point of big actions permits, *complete repair and restoration of the road must be undertaken.* In other words the surface must be worn out."

This is a logical deduction from our experience in New York State with this type of construction. Water-bound macadam, whether plain or surface-treated, is a light-traffic road at the best, and may be classed rightly as only semi-durable. Surely, the so-called permanent type used in this country, such as concrete, brick and bituminous concrete, would not be ground up and blown away as in the case of water-bound macadam. Any of

these types, which our experience has found more durable, probably would take care of the war zone traffic with ordinary maintenance and repair.

New York is having excellent results with its first-class concrete highway construction where such roads have been built outside of large cities for heavy motor and horse-drawn traffic. Highways of this type, leading from Buffalo, Syracuse and Albany, are taking care of a steadily increasing mixed traffic with no appreciable wear and a very low maintenance cost. This type has also the advantage of a low first cost, and can be maintained easily with ordinary labor without closing them to traffic.

Mr. Weir's article is excellent in that it gives the American highway engineer a very good idea of the kind and density of traffic, the methods used to repair water-bound macadam (the only type encountered), the grades, drainage, width and other details, but it does not convince one that the permanent types of road would be unsuccessful. It is certainly unfortunate that Mr. Weir could cover the field only superficially, and that he was unable to get into contact with officials who directed the road engineering, and who probably by this time have formed some ideas as to the types of roads needed in the reconstruction of the highways in France.

JOHN H. HUBER,
Resident Engineer, New York State Commission of Highways.
Syracuse, N. Y.

Concrete Floor Slabs Distribute Loads to Steel Bridge Stringers

Sir—The article in your issue of July 12, p. 65, entitled "Standard Bridge Floors of Concrete Slabs on Steel Beams," by William Snaith, assumes that the wheel loads of the roller are transmitted through the concrete slab to the steel beams below without being distributed by the slab.

Bulletin 28 of the Ohio State Highway Department, published in September, 1915, gives the results of a series of tests conducted by the writer which show that the slab does distribute concentrated loads in all directions and that the stringers below are not nearly so severely loaded as is assumed in Mr. Snaith's article. A synopsis of the results of these tests was published in *Engineering Record*, Nov. 6, 1915, and in *Engineering News*, Nov. 11, 1915. Other tests along the same line have been conducted by the United States Office of Public Roads.

The reduction in the amount of live load carried by a stringer and the more nearly uniform distribution of the load result in a considerable saving in the supporting steelwork and still allow an ample factor of safety.

Based on the results of these tests and others which it has conducted on bridge floors in service, the State Highway Department of Ohio uses the following assumptions in designing reinforced-concrete slab floors and their supports.

Reinforced-Concrete Slabs—For slabs without pavement or earth covering, with one or more concentrated loads on a line parallel to the main reinforcement, the slab extending in width each way from the point of application of the load a distance greater than the span, or supported at its edges by beams capable of supporting the resulting imposed weight, each foot width of slab shall be assumed to carry as concentrated loads each load divided by $(1.2d + 1.5)$, where d is the distance in feet from the load to the nearer support. In case two equal concentrated loads 6 ft. apart are on a line perpendicular to the main reinforcement and three or more feet from the nearer support, each foot width of slab shall be assumed to carry as a concentrated load the weight of one load divided by $(0.5d + 3.5)$. With pavement or earth covering or both, the above loadings per foot width of slab may be assumed as uniformly distributed loads, the distribution lengthwise of the slab to extend each way from the point of application a distance equal to the depth of earth covering plus twice the depth of pavement. Axle loads of railway cars may be considered distributed upon three ties.

Stringers for Reinforced-Concrete Floors—The greatest weight that will be upon any intermediate beam of a series of beams approximately uniformly spaced and not over 6 ft. apart, due to a concentrated load or to two concentrated loads 6 ft. apart upon a line perpendicular to and at the middle of the span, may be taken as equal to the amount of one load multiplied by one-sixth of the beam spacing in feet. If the concentrated load is at or near the stringer support, the total weight of one load shall be assumed as carried by a single beam. For intermediate postions of the load between the middle and a support the distribution shall be taken as proportional. If the arrangement of the stringers is such that a concentrated wheel load may be applied to the floor within one-half the stringer spacing of the outside stringer, it shall be proportioned to carry not less than one-half the weight of such wheel load, and in no case when a wheel load can be applied between the outside stringer and the next intermediate stringer shall the outside stringer be proportioned to carry less than an intermediate stringer.

The writer is indebted to John R. Chamberlin, Deputy Highway Commissioner in charge of the Bureau of Bridges of the Ohio State Highway Department for the above information as to its present practice.

CLYDE T. MORRIS,
Professor of Structural Engineering, Ohio State University.
Columbus, Ohio.

Automatic Flood Gates Are Patented

Sir—We see in *Engineering News-Record* of Aug. 9, 1917, p. 271, a description of automatic floodgates on the crest of the Nashua dam, Iowa, by C. W. Older, in which it is said that this particular type of floodgate "was imported from Switzerland by the Fargo Engineering Co." Not only in our own interest but also in the interest of your readers, we request you to state that the type of automatic floodgates described in the article mentioned is patented, and that the United States patents are controlled by our concern. The Fargo Engineering Co., Jackson, Mich., is our eastern American representative and by its intervention we furnished the detail drawings for the automatic gates at Nashua, imposing royalty on the owners of the dam.

BARRAGES AUTOMATIQUES S. A.,
Zurich, Switzerland. BY W. O. SOMME.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

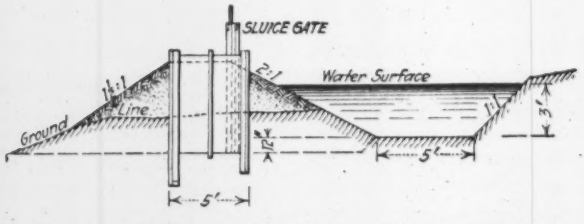
Simplified Cross-Section for Canals on Hillside Locations

By Vaughan Wood
Montgomery Creek, Calif.

FOR canals that follow the contour of the hills, where the side slope is equal to one foot in ten or steeper, the Waterford Irrigation District, Stanislaus County, California, has been using a simplified cross-section. The same bottom width of canal and the same cross-section of lower levee are used as for flat-section canals. The upper side is excavated to a 1:1 slope and no levee constructed. This design effects economy in excavation and also does away with the pipe drain beneath the canal, since drainage goes directly into the canal section.

However, side spill gates are placed in the lower levee about one-half mile apart, preferably in a wash that can carry away drainage. These spill gates are built with a floor 1 ft. below the bottom of the canal, and when the irrigating season is over they are opened and allow the storm water to sluice out a large part of the accumulated sand which may be in the bottom of the canal. Besides effecting a saving in excavation and affording the advantage of being able to use the water which otherwise would be wasted under the canal sections through the drains, such practice prevents water from forming boggy places in the flat ground at the base of the hill.

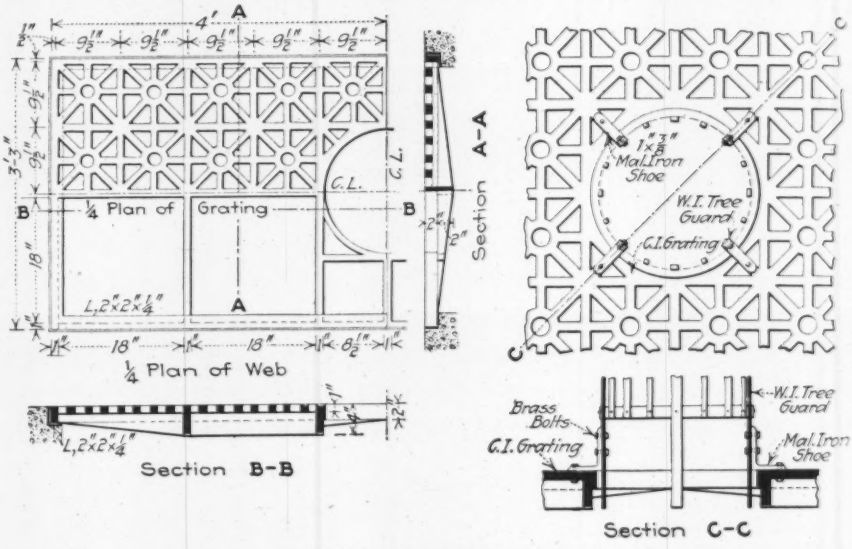
Another feature of interest in connection with these canals is the method used in locating a normal-cut canal from profile alone. The difficulty encountered in this regard was due to the fact that the normal center cut was very variable, since the side slopes varied with extreme frequency. The method devised and used was to cross-section the canal without setting cut or fill stakes; then yardage was figured and mass diagrams were plotted. By means of profile and mass diagrams together, slight changes could be made with one relocation that would approach the economical location.



ADVANTAGEOUS DESIGN FOR CANAL ON SIDE HILL

Cast-Iron Gratings Protect Tree Roots in Albany Business Street

STATE STREET, Albany, N. Y., furnishes an example of how trees may be preserved even in the business thoroughfare of a large city. In order that the roots of the tree may have plenty of air and moisture, they are surrounded by an 8 x 3½-ft. cast-iron grating, which is flush with the surrounding sidewalk or pavement and forms a part of it, but nevertheless protects the roots. The accompanying sketch shows the details of the grating. It was designed by the Albany Bureau of Engineering, which is under F. R. Lanagan, city engineer.



ALBANY SHADE-TREE GRATING

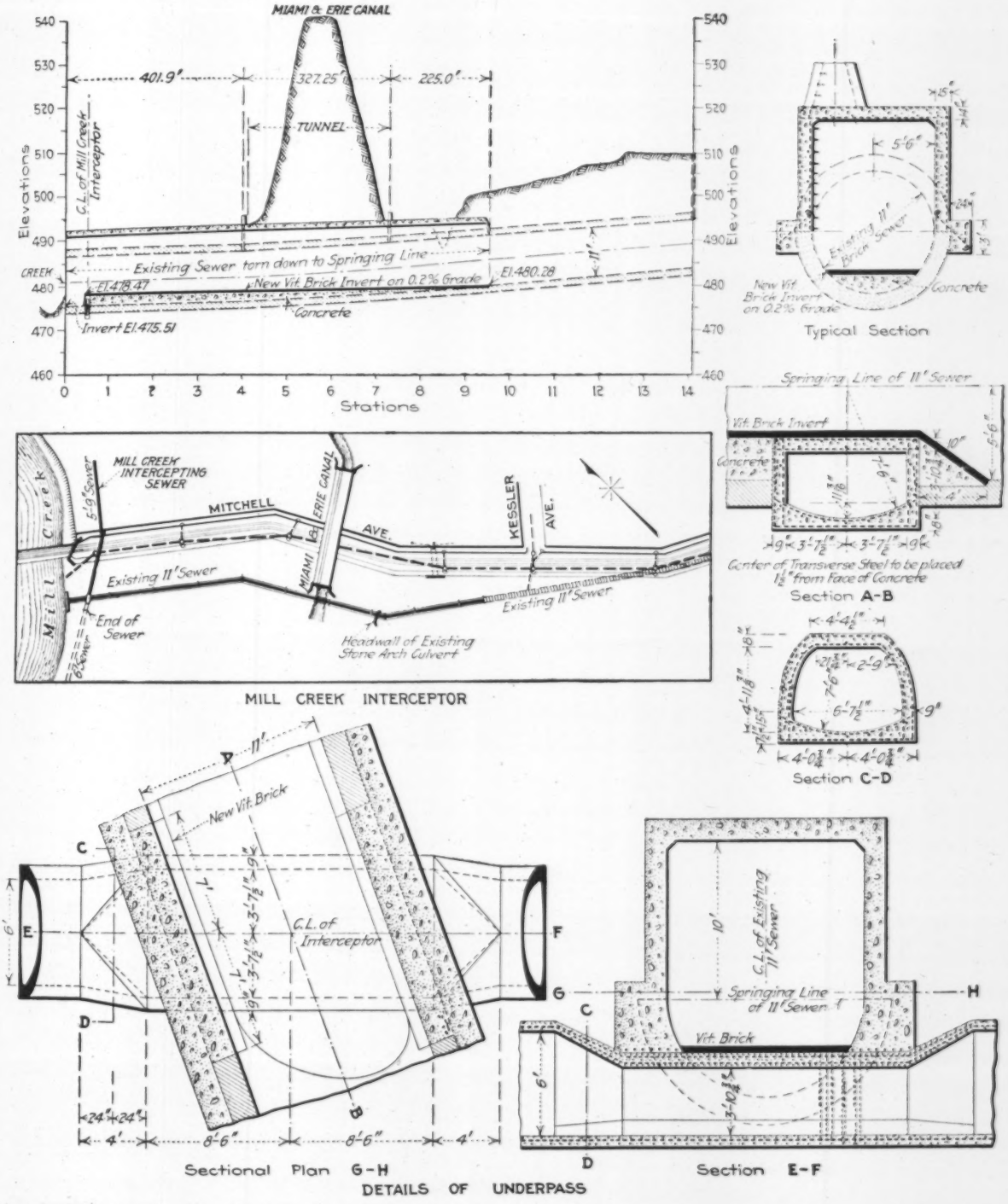
Enlarging an Old Brick Sewer

REMOVING the upper half of a four-ring 11-ft. circular brick sewer is the delicate part of a contractor's job on a sewerage improvement now in progress in Cincinnati. The removed portion of the old sewer is being replaced by a rectangular reinforced-concrete structure of the form shown by the accompanying typical section. A new invert is being placed on top of the old invert at a change of grade, in order that the flow line at the sewer outlet may be 3 ft. higher than before. The work is part of Contract 4 of the Mill Creek interceptor, and is being done by D. P. Foley, a Cincinnati contractor.

The three main reasons for the removal and reconstruction of the old 11-ft. sewer were: (1) That the

Mill Creek interceptor, which is located 50 ft. from the outlet of the trunk sewer at Mill Creek (shown in plan and elevation on the accompanying drawings), may pass under the trunk sewer without using an inverted siphon; (2) that the trunk sewer, which is the outlet for a residential area of 1700 acres, may have its capacity increased from 860 to 1800 sec.-ft. or to approximately the estimated probable run-off for this district; and (3) that the invert at the outlet end at Mill Creek may be raised to the level of the creek bed instead of being 3 ft. below the bed of the creek.

Over the old sewer was an earth filling having an average depth of about 15 ft. This was removed by a ¾-yard steam shovel. The old sewer was uncovered to a point 2 ft. below the springing line and then the concrete haunch walls shown in the typical section were placed. Next, the brick arch was removed by hand labor in two operations—first, removing the outer ring



NEW INTERCEPTOR WAS PASSED BENEATH OLD TRUNK SEWER WITHOUT INVERTED SIPHON, CAPACITY OF OLD SEWER DOUBLED, AND OUTLET RAISED ABOVE CREEK BED

of brick by picks and bars, and, second, breaking the inner rings by sledging and permitting the broken material to fall on a temporary platform, from which it was removed by hand labor. Wooden forms were then set, the steel placed, and the complete concrete section above the springing line poured in one operation.

Some of the troublesome parts of the work were: (1) The fluming and caring for a dry-weather flow in old sewer of about 1,500,000 gal. of sewage per day, and in times of storm the run-off from a drainage area of about 1900 acres. As there were 26 days during June and July on which the precipitation was 0.01 in. or over, the interference was rather serious. (2) The placing of this large rectangular section in tunnel and beneath the Miami and Erie Canal which, at this point, is on an earth fill about 55 ft. above the springing line of the old sewer, and in the tunnel the removal of a stone arch culvert constructed at the time the canal was built, in addition to the removal of the arch of the old brick sewer.

The main interceptor has a 6-ft. semi-elliptical section. Its flow line and the shape of its invert underneath the trunk sewer were retained, the increased capacity in the underpass being obtained by increasing the width of the intercepting sewer.

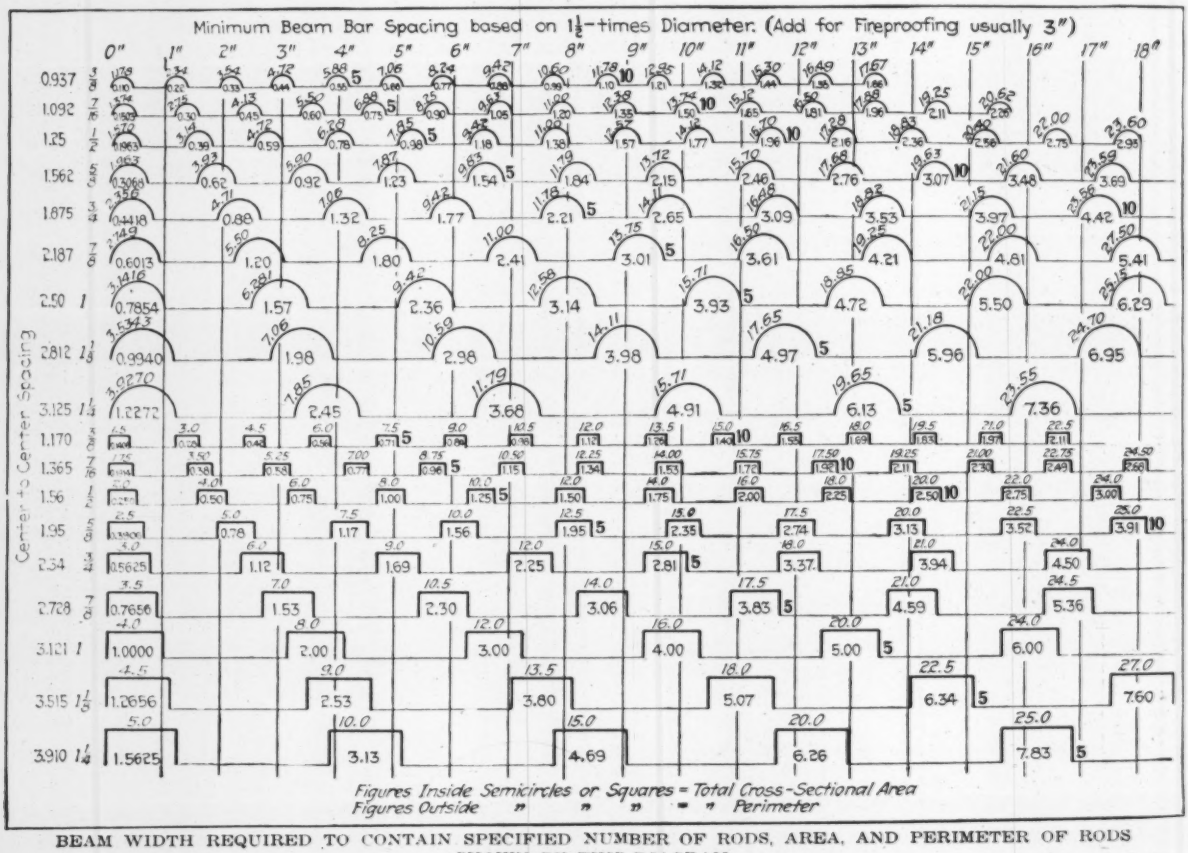
Diagram Facilitates Spacing of Reinforcing Bars

A DIAGRAM which aids a reinforced-concrete designer to select the proper number and size of rods in a beam has been devised by Ralph R. Leffler, of the Concrete Steel Products Co., Chicago. The [illegible] gram is based on the Chicago requirement of a spac[illegible] 1½ times the rod diameter and represents to scale [illegible] disposition along a beam of square and round rods fr[illegible] ⅜ in. to 1¼ in. diameter. The figures inside the se[illegible] circles or squares give the total cross-sectional a[illegible] of the rods up to the one that is noted, while the figu[illegible] outside give the total perimeter, to be used in figuri[illegible] bond.

To illustrate the use of the diagram, the over-all d[illegible] tance of seven ⅞ in. round bars (area = 3.09 sq.in[illegible] is seen to be 12 in., to which 3 in. is usually added fo[illegible] fireproofing, making the required width of the beam to accommodate the bars in one layer of minimum spac[illegible] ing equal to 15 in. If a width of 15 in. is too great, practically the same steel cross-sectional area can be secured by using four ⅞ in. square bars (area 3.06 sq.in.) whose over-all distance equals 9 1/16 in., to which adding 3 in. for fireproofing gives a beam of 12 1/16 in. or 12 in.

Further study of the tabular diagram will show it to be very advantageous when different sized bars totaling a required area are used in a beam, when two layers are used, when bond is the controlling factor, when either squares or rounds can be used as may be more economical.

In case the requirements for the spacing of bars on any particular job or in any city vary from those of the Chicago code a similar tabular diagram conforming to those particular requirements can be constructed very easily.


Minimum Beam Bar Spacing based on 1½-times Diameter. (Add for Fireproofing usually 3")
Center to Center Spacing
Figures Inside Semicircles or Squares = Total Cross-Sectional Area
Figures Outside " " " " = " Perimeter

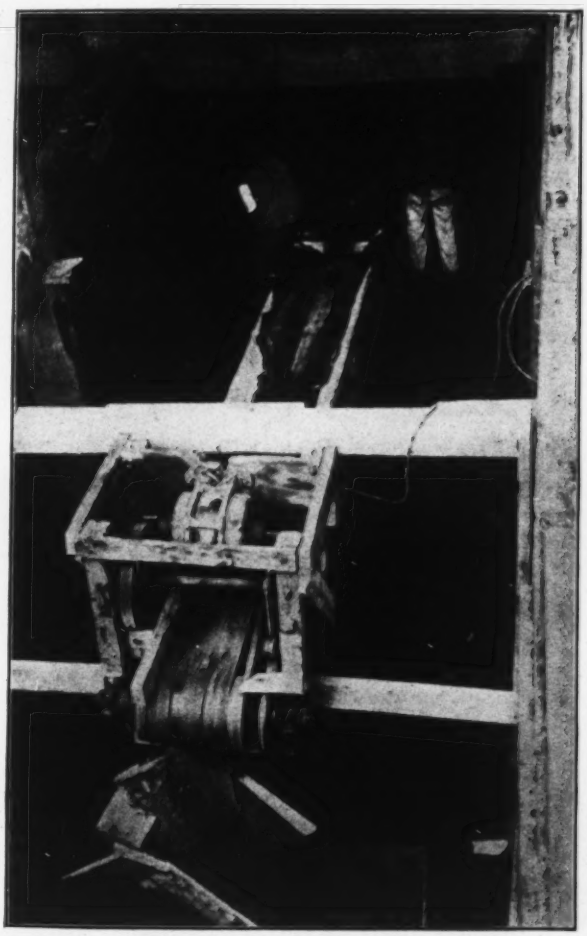
BEAM WIDTH REQUIRED TO CONTAIN SPECIFIED NUMBER OF RODS, AREA, AND PERIMETER OF RODS SHOWN BY THIS DIAGRAM

HINTS FOR THE CONTRACTOR

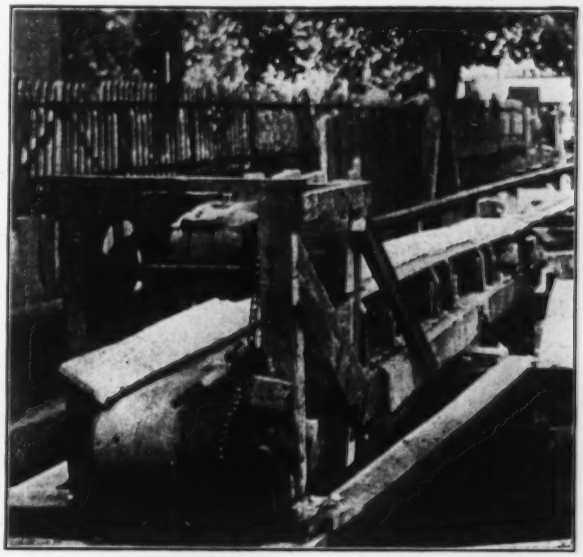
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Portable Belt Conveyor Takes the Pitch Out of Shoveling

SHORT portable belt conveyors are used in a section of the Nostrand Avenue subway, under construction in Brooklyn, to fill cableway buckets with earth from under the street car tracks. The conveyors are made in 20-ft. sections, each with a 1-hp. General Electric or Westinghouse motor set above one end, as shown in the picture. The frame of the section consists of two 3-in. planks, with a 1-in. floor nailed on. The rollers are fastened to supports carried by this floor. The floor is made tight to prevent dirt from falling through to the wrong side of the belt and injuring it by getting next to the rollers. These sections are rather heavy for hand handling, but where the cableway is handy they are moved easily. Several men may shovel on one of these belts at the point nearest to where they are digging, and all the dirt will be taken away and dumped at the upper end of the conveyor. Here there is a pivoted chute, as seen in the picture. Swinging this slightly about its pivot, which is vertical, throws the dirt into the other bucket. By this method the cableway may set down an empty bucket alongside the full one, and the dirt stream may be shifted into it without moving it to the point where the full one was.



SMALL BELT CONVEYOR GETS EASILY INTO PLACES HARD TO REACH



SPEED REDUCTION IS THROUGH THE GEAR AND CHAIN DRIVE

These conveyors are to be employed on several sections of the work, as the two steam shovels are not able to get along as fast as desired on account of cramped quarters and inability to get rid of earth as fast as it can be loaded. On a finished section of the work they were used in large numbers, being arranged in tiers and running in the same direction as the car tracks carrying the buckets. In this way the shovelings of many men were brought together in buckets, to be taken up out of the pit at one point.

The work is being carried out by the Newman & Carey Subway Construction Company.

Planks Laid on Hill Save Breakage in Rolling Brick Pavement

BY JAMES A. CAIN
Wilkinsburg, Penn.

IN LAYING brick paving at Verona, Penn., recently it was found impossible to ascend a steep grade over newly laid bricks with a road roller because the friction pulled the rows of brick over and threw many of the bricks out of line. The roller could descend the grade without trouble, but in order to reach the top a long detour through side streets was necessary, involving great waste of time. A roadway of transverse

planks about 200 feet long and a little wider than the roller was then laid. The roller made a round trip over this planking in one position and the planking was then moved sidewise. The trips were repeated until the entire street had been rolled. The results were very satisfactory, the original alignment was retained, and only a few bricks were broken, whereas bricks were turned over and a good many cracked in the course of the attempt to roll the grade without planks. Shortly after the work at Verona was finished the same method was successfully used in rolling hills on brick paving at Belle Vernon, Penn.

On both paving jobs J. I. Dick, general contractor, Scottdale, Penn., did the work, and Douglas & McKnight, engineers of Pittsburgh, supervised the construction. The writer represented the engineers on the Belle Vernon work.

Concrete Plant Places Backfill

A CONCRETE-MIXER car used in building retaining walls is used also for backfilling behind the walls, on sections of the Brighton Beach Rapid Transit lines in Brooklyn.

The plan, devised by N. L. Kennedy, superintendent for the Intercontinental Construction Company, makes use of a track mixing plant. Dump cars loaded by the steam shovel, or by motor trucks dumping over the completed wall, are run to the concreting car, which has a Lakewood mixer equipment. The earth is shoveled into the charging hopper. This delivers it to the drum, where water is added. The wet material is discharged into the elevator bucket, which in turn dumps it into a chute extending over the retaining wall. The material is wet enough to flow for a distance of 30 to 45 along the back of the wall.

This plant has averaged 100 cu.yd. of fill in 10 ho with a crew of two hoisters and six laborers. cost is about 25c. per yard. This method of filling used at points which are inaccessible by road, and work is done at odd times when the mixer is not in building the concrete walls.

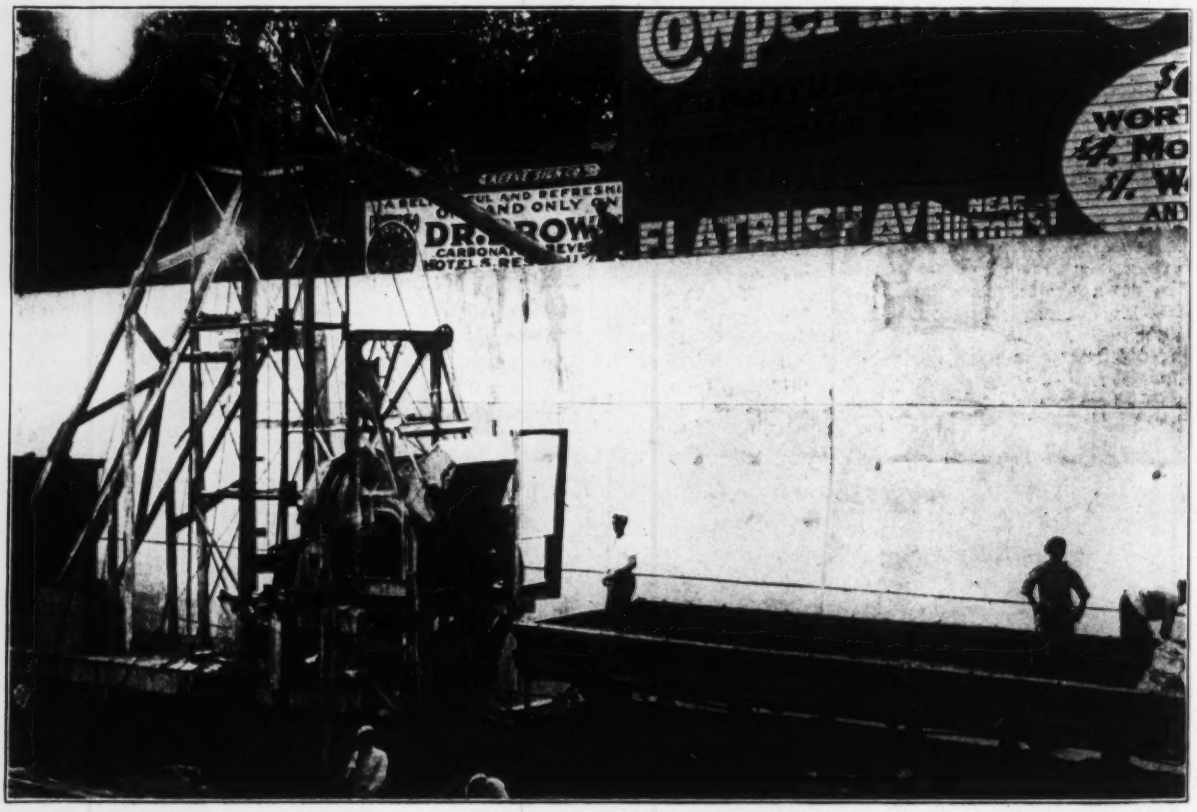
Ropes Simply Stretched Catch Form Panels in Stripping Floor

By Samuel Warren
New York City

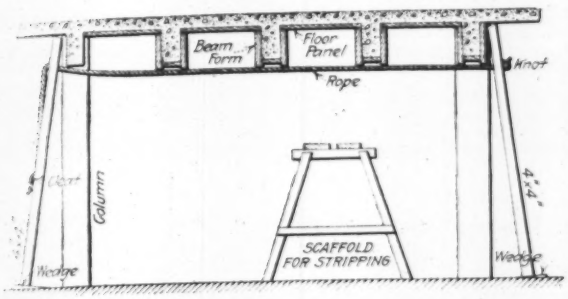
A SIMPLE RIG for catching floor forms in stripping and one which insures the minimum of damage, is illustrated in the sketch.

The rig consists of pairs of posts, each made up of two pieces of 4 x 4 cut slightly longer than the clearance between the floor and the ceiling. About a foot below the top of each post a hole is bored. An inch rope is passed through the holes and knotted against one of the posts. The posts are then set as shown in the sketch, and are held tightly in place by a wedge at the bottom of each. The loose end of the rope is then pulled taut and held by means of a cleat.

After the shores are removed and the floor joists for the floor panels are knocked out, a scaffold consisting of planks on horses is placed underneath. From this the men work to loosen the beam and girder forms and floor panels. These fall but a small distance, being caught by the ropes. In case a form breaks loose, the workman can prevent injury to himself by ducking below the level of the ropes.



CONCRETE PLANT PLACES 100 YARDS OF BACKFILL A DAY

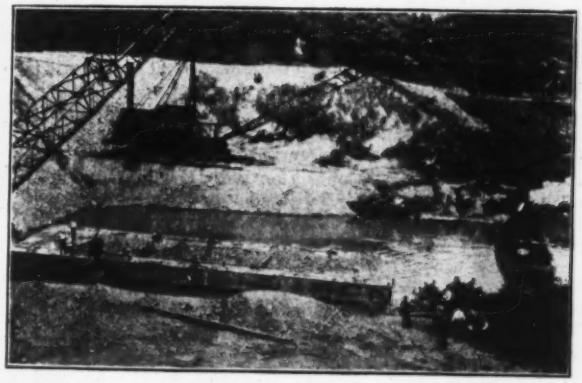


ALL THE FORMS IN A BAY LOWERED TO FLOOR AT ONCE BY SLACKING ROPES

As soon as all the forms have been stripped they are lowered to the floor by loosening the ropes simultaneously at each cleat. The same apparatus can be used for stripping flat slab panels by leaning the opposite posts away from each other. A strain on the rope only serves to hold the posts more firmly, because they are slightly longer than the distance from the floor to the ceiling.

Canal Is Excavated to Accommodate Spoil from Dump Scows

EXCAVATION of a dumping site for dump scows was made necessary by the absence of available dumping grounds, in part of the canalization of the Hudson River for the Champlain Canal. To provide for this need, the contractor excavated a canal parallel with and a few hundred feet from the river bank. It is 60 ft. wide and 12 ft. deep, and about 3000 ft. long. Two dragline excavators with 105-ft. booms and 3½-yd.



EXCAVATED MATERIAL IS DUMPED BY BARGES INTO CANAL AND THEN HANDLED BY DRAGLINE MACHINES

buckets worked on opposite sides of the cut, and deposited the spoil as far away as possible, leaving wide berms on which the machines could return.

Tugs bring the 200-yd. steel barges to the end of the canal where they are dumped. The dragline machines then pick up the dumped material and place it between the spoil banks, making a pile about 50 ft. high and 250 ft. wide. As the machines work backward along the berms they gradually fill the canal and the space between the spoil banks. The work is shown in the accompanying view, which shows the canal partly filled and a barge in position for dumping. At the right is the Hudson River.

This work is being done near Waterford, N. Y. The Dunbar & Sullivan Dredging Co., of Detroit, has the contract and Richard Goode is its superintendent. The construction is under the supervision of Geo. D. Williams, division engineer, Department of the State Engineer and Surveyor. John McBride, senior assistant engineer, has direct charge.

Road Machine Does Heavy Side-Hill Grading at Rapid Rate

AN AUSTIN "Mammoth grader" has been used effectively in Logan County, Arkansas, in making side-hill cuts at a rapid rate. An interesting example of this work was the widening of a mountain trail between Boonville and Sugar Grove into a wagon road with

OUTFIT DOES MILE OF HEAVY GRADING IN FIFTEEN HOURS

no other earthwork than could be performed by the use of this machine. As the illustrations show, the extended axle permitted the cutting blade to dig into the side-hill bank, the cutting effect being further facilitated by the offset hitch attaching the traction engine to the grader. On this work the grader blade dislodged rocks weighing up to 400 or 500 lb. apiece. The road was graded wide enough to admit the passing of two motor cars or loaded wagons at any point. The first mile of the road, graded under unusually severe conditions, was completed in 15 hours of actual working time.

Cantonment Road Building in Record Time

A record-breaking piece of road building was completed last week in connection with the army cantonment near Louisville. This is one of the few military establishments that have built permanent roads. In 63 working days the contractor completed 63,360 sq.yd. of Trinidad asphaltic concrete highway laid on a concrete base, or about 6 miles of road 18 ft. wide. A mile of the road was over a 4-ft. fill, and immediately upon its completion a traffic count showed that 4000 vehicles passed over it within the first hour. Most of these vehicles were motor trucks and wagons carrying loads of from one to five tons. The record made by the Bickel Asphalt Paving Co., the contractor, is all the more remarkable in view of the fact that it was necessary to haul and crush all the stone used on the work.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

3000 Applicants for Road-Building Regiment

Men from 37 States, Panama and Alaska Accepted as Result of Engineering News-Record's Recruiting Campaign

More than 3000 applications have so far been received for enlistment in the new 23rd Regiment of Engineers which is to go to France immediately and build and rebuild roads "over there."

This information was furnished to the Washington correspondent of *Engineering News-Record* this week by Col. E. N. Johnston, U. S. A., the commanding officer of the new, big unit, in behalf of which this journal has been waging a recruiting campaign which was inaugurated in the Oct. 4 issue. The applications for service in this remarkable unit of the new army, Colonel Johnston states, are now pouring in at an unprecedented rate, so far as the system of military enlistment is concerned. The commanding officer hopes that he will be able to take care of all of those who apply.

The regiment is being mobilized at Camp Meade, Admiral, Md. Colonel Johnston has his office and his adjutants and assistants at 1419 F St., Northwest, Washington, D. C., where all applications for enlistment in the regiment should be addressed, but out at Camp Meade, just outside of Washington, there have already assembled for training about 850 men who have been accepted for the new "crack corps" among the engineers of the army, and these are being added to in big lots every day.

"We have applications from and we have accepted men from 37 states in the Union, the District of Columbia, Panama and Alaska," Colonel Johnston said. "We had a few from Canada, too. We have men from Harvard, Princeton, Yale, Cornell, Pennsylvania and state universities including Michigan, Virginia, Wisconsin, etc. We have men from Massachusetts Institute of Technology, Stevens and other institutions."

Colonel Johnston went on to explain that it is not only the college man who has a great opportunity in the big, new regiment, but that opportunities are offered to many other classes of men who are road builders and highway men.

"While in certain cases people especially qualified may be given definite promises of positions," Colonel Johnston said, "no more commissions will be granted for the present, although everyone will have a chance to earn a commission, in actual service. We are not hearing enough from the road-roller men, the stone-crusher men, the quarry men, the drill runners, the bridge carpenters, the blacksmiths, the machinists and the general mechanics.

"These men are just as much desired by the regiment as college engineers. The opportunities for advancement for these men are just as great as they are for college engineers. Lack of a college education will be no handicap whatever to advancement in the regiment. We want to hear from some men who are not only proficient in some of the positions specified, but who, in addition, can play some musical instrument. We want some snare drummers and fifers."

Colonel Johnston made it clear that the men who go to France with this outfit are going to get an education in highway engineering that they could not get in any college in the world. He said that when these men come back from France they will be worth twice as much to employers in the United States as before. It was said in Washington that the men of the 23rd Engineers will be sought by employers all over the country on their return.

It was pointed out that the traffic on many roads in France with which the 23rd will have to do will require more maintenance work in a month than would a similar road in the United States in a year. The men of the 23rd will work under conditions such as they have never met before; conditions which will inspire their professional interest, their sporting interest and their patriotism.

Applications for enlistment may be made on the form on page 816-a of this issue.

St. Joseph, Mo., Grants Restricted Garbage Franchise

The City Council of St. Joseph, Mo., has passed an ordinance granting a franchise to the Hockenberry-Boyer Co., under which that company is given the privilege of collecting garbage, trash, ashes and manure under certain restrictions. The details of the ordinance provide for the collection of wet garbage for 60 cents a month the first year, 50 cents a month the second year, 40 cents the third and fourth years, and free service the fifth year to all householders who have used the service for the first four years. Al trash, ashes and manure will be removed for $1 a cubic yard.

The company expects to use motor trucks and tightly covered tin cans, and will feed the wet garbage to hogs outside the city limits. The life of the contract is to be five years, and the city retains the option of providing universal free service to the householders after three years by paying $1250 a month to the contractors.

New West Side Improvement Plan Offered

Scheme for New York's Freight Problem Offers New York Central 25-Year Lease

General features have been announced regarding a new solution for the West Side problem of the New York Central R.R. in New York City, involving the freight line from Spuyten Duyvil to St. John's Park. The plan was developed by the joint committee of the Board of Estimate and the Public Service Commission, acting in accordance with the law passed last spring. The most radical feature of the new proposals is the retention by the city of the waterfront, the railroad to pay rental therefor and the city to be empowered to terminate the agreement after 25 years. A public hearing took place Oct. 18, and little opposition to the plan was offered. The New York Central was not represented, however, and a few days before the hearing the company announced its flat rejection of the scheme.

These are the principal new financial and operating features of the plan:

Rental to be paid by the railroad, readjusted every 25 years—city waterfront and other property to be leased and not sold to the company.

The railroad to be wholly upon city streets or public property.

The railroad's rights to be subject to recapture by the city, and to be terminable at the end of 25 years without compensation therefor.

The use by other railroads of the structures under reasonable terms.

New engineering features include:

Connection with Grand Central Station for passenger service.

Partial depression under a roof of the tracks on the present right-of-way along Riverside Park.

Entire removal of waterfront yards and terminals in Manhattan Valley, these instead to be located east of Riverside viaduct.

The law fixes Dec. 1 as the latest date for the Board of Estimate and the Public Service Commission to effect an agreement with the New York Central. Failing in that, the Board of Estimate loses all jurisdiction. The plan as set forth is not accompanied by any new maps or estimates, and railroad officials point to the shortness of the time available for the completion of such plans. In any event, however, the company holds that its title to its present right-of-way has been fully established, and it declines to consider any substitution of a terminable leasehold for that title, whereby an unfriendly administration might destroy its entire terminal.

Toledo Plans Extensive Sewer Improvements

A bond issue of $2,800,000 for intercepting sewers, pumping plants and sewage works is to be submitted to popular vote Nov. 6. If the bonds carry, as is expected, the City Council will be asked to issue $700,000 of the bonds at once to build the Ten-Mile Creek interceptor and Bay View Park pumping plant. This interceptor will include three miles of 72-in. sewer in tunnel and three miles of 42- to 72-in. sewer, with at least two inverted siphons. The ultimate capacity of the pumping plant will be 50,000,000 gal. It is hoped that the contracts for this work can be let early in 1918. Three other intercepting sewers, a smaller pumping plant and a large sewage-treatment plant will be constructed later. H. C. McClure is city engineer and W. G. Harmon, sanitary engineer.

Interstate Commerce Commission Divides Its Duties

To facilitate the disposal of its docket the enlarged Interstate Commerce Commission, under authority granted by Congress in the act enlarging the commission, has divided itself into three sections. Commissioners McChord, Meyer and Aitchison will handle valuation matters, Commissioners Clark, Daniels and Woolley will deal with certain rate applications and requests for suspension and with the transportation of dangerous materials, while Commissioners Harlan, Hall and Anderson will have the disposition of all board of review cases which have been submitted "and those not hereafter orally argued before the commission or any division thereof."

The three divisions will alternate in hearing cases set for argument, each division sitting for one month.

Russian Society of Engineers Gets Recognition

Official recognition by the Russian Mission to the United States has been accorded the Russian Society of Engineers of Chicago. Through this source the society has been able to formally tender its services to the Russian Government in all matters pertaining to engineering. It has offered not only the personal services of its members, many of whom are of high standing in the profession, but it also will act in an advisory capacity in procuring American engineering skill and in introducing American machinery and materials. M. C. Winokur, 1248 North Kedzie Ave., Chicago, is secretary.

Rivers and Harbors Congress Will Be Held in Washington

It has been announced that the fourteenth annual convention of the National River and Harbors Congress will be held in Washington, D. C., on Dec. 5 to 7 of this year. Addresses will be made by Secretaries Baker, Daniels and Redfield, General Black and others.

Public Health Association Had War Program

Army and Civil Population Problems Considered—Sanitary Engineering Section Profitable

HEALTH problems of the war and many others growing out of it occupied a large place on the program of the forty-fifth annual meeting of the American Public Health Association at Washington last week. In fact "War Program" appeared at the head of the official schedule for the meetings. Besides the general sessions, the convention met in sections—sanitary engineering, laboratory, industrial, hygienic, public health administration, vital statistics, sociological, and food and drugs.

The General Sessions

The presidential address of Dr. W. A. Evans, Chicago, Ill., dealt chiefly with the health of troops in army cantonments. Water-borne diseases are so well in hand that these received only passing mention in the address. Concern was expressed as to lack of air space and ventilation in the camps of which the speaker had knowledge. Civil authorities adjacent to camps should make their communities safe from communicable diseases to which soldiers and sailors are subject. After the war, soldiers, sailors and members of the medical staffs will be a great potential health force in the communities to which they return. The doctors will be available as health officers and the engineers and bacteriologists will also be available for public-health work. This, with health insurance, should give a new impetus to health work after the war.

In similar vein Dr. W. C. Gorgas, surgeon general, U. S. A., urged the increased importance of public-health work in war time. With 1,500,000 men in camps the danger from infection from without is great. Infection from within can be controlled. In behalf of the army, General Gorgas expressed the hope that the American Public Health Association will keep up its health activities. Dr. W. C. Braisted, surgeon general, U. S. N., said that this country now leads the world in naval hygiene. The death rate in the navy last year was 4.4 per 1000, or corrected for age, about 8.

Work of the United States Public Health Service

Dr. John W. Trask, assistant surgeon general, United States Public Health Service, outlined the work being done by his branch of the Government to protect the troops in camp by caring for the health of the extra-cantonment zones. State and local authorities have conferred their powers on the United States Public Health Service and are coöperating in this work. Sanitary surveys of these zones were made as soon as sites were selected and house-to-house inspections are being continued, with special reference to water-supply and the detection of communicable diseases.

A large and enthusiastic audience listened to an inspiring address by Herbert C. Hoover, food administrator.

Resolutions were adopted by the convention urging President Wilson to add to his economic and other war-need programs one for the conservation of the health of our civilian populations; advocating the provision of ample funds for the work of the United States Public Health Service; and urging measures for greater coöperation between local, state and provincial health authorities and the general governments of the countries included in the membership of the American Public Health Association—the United States, Canada, Cuba and Mexico.

Sanitary Engineering Section

Although scheduled for a single session, the number and interest of the papers and committee reports presented to the Sanitary Engineering Section was such as to require three sessions. T. C. Hatton, Milwaukee, presented a notable summary of activated-sludge conclusions, which will be abstracted in a coming issue. Langdon Pearse, Chicago, sent a closely related paper, dealing with the treatment of packing-house wastes for the activated-sludge process. This is abstracted on page 777.

The work of the Essex County Mosquito Extermination Commision of Essex County, New Jersey, which has included 1,800,000 ft. of ditching, was described in a paper by Dr. Ralph Hunt. W. J. Mauer, engineer of the Chicago Ventilation Commission, sent a paper on army barracks ventilation. Some of the members appeared to think that Mr. Mauer was urging a counsel of perfection in advocating such things as a separate building for each eight men.

Notable Committee Reports

Two epoch-marking committee reports were adopted, each having been presented a year ago at the Cincinnati meeting and held open for criticism and revision. For the Committee on Sanitary Control of Waterways, H. P. Eddy, chairman, Boston, Mass., reported that no criticisms of the proposed fundamental principles and code for the sanitary control of waterways had been received and that no changes were recommended, so the 1916 report of the committee was adopted. This report in full was printed in the *Journal* of the American Public Health Association for April, 1917; the code appeared in *Engineering News*, Nov. 9, 1916, p. 876, and in the *Engineering Record*, Nov. 11, 1916, p. 582.

The Committee on Sewerage and Sewage Disposal, through George S. Webster, chairman, Philadelphia, presented in revised form the definitions of sewerage and sewage-disposal terms submitted a year ago. The revised terms were adopted. Some of the original definitions were printed in *Engi-*

neering News, Nov. 2, 1916, p. 858. The revised terms were published in full in the *Journal* of the American Public Health Association for October, 1917.

STATE CONTROL OF SEWAGE WORKS

For the Committee on Sewage Works Operation and Analytical Methods, W. L. Stevenson, chairman, Philadelphia, acting on a request made at the Cincinnati meeting, amplified the ideas of state control of sewage works expressed in 1916. In part, the 1917 report said:

"Generally the degree of such control should vary inversely with the quality of maintenance provided by the municipality or other owner of the works and directly with the possible danger caused by falling off of efficiency in operation.

"It is not a proper function of the state, excepting in cases of emergency, to do more than keep watch over the local authorities or to prod them to greater efforts. The ideal condition would be for each municipality or owner to so operate its sewage-treatment works through its own agents—either trained employees constantly on the payroll or special consultants regularly engaged—that the work of the state would be resolved simply into the study and checking of the results accomplished by the works, but this ideal condition has not yet been obtained except in isolated instances.

"The most desirable plan of state control comprises routine inspection, advice when deemed necessary, general supervision, adequate police power to enforce proper operation, and authority to require regular tests and records.

"The desideratum in the operation of sewage-treatment works under state control may well be likened to the conditions existing in our national banks. The examiner checks the accounts and methods of business and, when found to be in accordance with law and the safety of the public, does not interfere; but if the bank is in an unsound condition the central governing power steps in and requires changes to safeguard the public, and, if the emergency is extreme, actually assumes temporary control."

As in its reports for 1914, 1915 and 1916, the committee again urged that owners of sewage works should employ competent trained employees for operation and should also engage experts for periodical inspection and general supervision of the works.

REFUSE COLLECTION AND DISPOSAL

The Committee on Refuse Collection and Disposal, through S. A. Greeley, chairman, Chicago, Ill., reported that the war had caused a slackening in the construction of new disposal works and a falling off in collections estimated at 30%. The two notable installations of the year have been the Cobwell reduction works for New York City and the Stirling incinerators at Toronto. In a paper dealing with the relation of the war to garbage collection and disposal, I. S. Osborn brought some striking facts and figures which are presented on page 778.

Shandaken Tunnel Contract Has Not Yet Been Awarded

The statement in *Engineering News-Record* of Sept. 27, to the effect that the New York Board of Water-Supply had awarded to the Degnon Contracting Co. the contract for the 18-mile Shandaken tunnel, was incorrect. The Degnon company was low bidder, but the Board of Water-Supply has taken no official action in awarding the contract.

Bingham Succeeds Abbot in New York Office

Brig. Gen. Theodore A. Bingham has been returned to active military duty and will assume the duties as division engineer of the Northeast Division, Corps of Engineers, U. S. Army, with headquarters in New York City, succeeding Col. Frederick B. Abbot, who has been assigned to the work of organizing and training troops for the engineering branches of the army. General Bingham was police commissioner of New York City from 1906 to 1909, and in 1911 served for a short time as chief engineer of the Department of Highways, New York State. From 1911 to 1915 he was consulting engineer for the Department of Bridges. General Bingham has been on the retired list of the army since 1904, following an accident at the Buffalo Exposition.

Chicago Sanitary District Asks U. S. for Bridge Steel

Inability to obtain structural steel owing to the action of the United States Government in commandeering the steel supply is holding up the contractor for railroad bridges across the Calumet-Sag drainage canal of the sanitary district of Chicago. The bridges are on the last two sections of the work which cannot be completed until the bridges are constructed. In view of the importance of the canal in preventing pollution of the public water supply, and in view of the large amount of money already invested in this work, the district considers that there is a public necessity for the construction of the bridges. It has therefore requested the United States Government to permit some steel company, or companies, to furnish the contractor the 1200 tons of steel necessary for the work. The Government has already agreed to allow the supplying of steel to the contractors for the Chicago River bridges for the City of Chicago.

Defiance, Ohio, Will Purify Its Water Supply

The City Council of Defiance, Ohio has authorized the director of public service to enter into a contract with the W. J. Sherman Co., of Toledo, Ohio, to make a preliminary survey and investigation looking toward the purification of the city's water-supply.

Santa Barbara Wants City Manager

Under a new city charter which will take effect Jan. 1, 1918, Santa Barbara, Calif., will have a city manager. The city manager committee of the council-elect wishes applications for the position before Dec. 1, 1917. The first letter from candidates should state qualifications and salary desired and should contain references. The city has a population of about 20,000. The committee announces that the salary paid is "dependent on the man."

President Approves Selection of Nitrate Plant Site

On Oct. 16 it was announced that the President had approved the selection of a site at Sheffield, Ala., for initial ammonia and nitric acid plants to be constructed by the Government out of the $20,000,000 appropriation made by the last Congress for this purpose. This site is on the Tennessee River, just below Muscle Shoals, and near the phosphate beds of Tennessee.

In discussing the paper on state health board control of refuse disposal, by E. D. Rich, abstracted elsewhere in this issue, Theodore Horton, chief engineer of the New York State Department of Health, Guy C. Emerson, Jr., acting chief engineer of the Pennsylvania Department of Health, and M. N. Baker, of the editorial staff of *Engineering News-Record*, questioned the wisdom of state boards of health attempting control of a service having so little relation to public health.

There seemed to be dissent also to portions of the report of the Committee on Plumbing and Drainage of Buildings (C. H. Wells, chairman, Montclair, N. J.), which asserted a close relationship between plumbing and public health and argued that plumbing control should be vested in health rather than building departments. The report, which contained an outline of the general principles of good plumbing, was ordered sent to the section membership for discussion, with the understanding that a year hence the committee will submit another report, giving more detailed attention to the control of water and sewer connections—which are now in a twilight zone of little or no control, resulting in much water waste and the overtaxing of sewage works through leakage.

NEW OFFICERS ELECTED

Dr. W. A. Evans, Chicago, was re-elected as president of the association. For the Sanitary Section, George S. Webster, Philadelphia, was selected as chairman; E. A. Fisher, Rochester, N. Y., as vice chairman, and S. A. Greeley, Chicago, as secretary. The Laboratory Section will have Dr. George W. McCoy, United States Hygienic Laboratory, Washington, D. C., as chairman; R. B. Fitz Randolph, Trenton, N. J., as vice chairman, and Dr. Charles Krumwiede, Jr., New York City, as secretary. Dr. Thomas Hastings, Toronto, was chosen as chairman, and C. H. Wells, Montclair, as secretary of the section on Public Health Administration.

New Orleans Will Collect and Utilize Its Refuse

Cobwell Process for Garbage—Refuse Sorted and Sold—Tailings Incinerated

The Commission Council of New Orleans, La., has by ordinance approved a project for the municipal collection and disposal of garbage and other city wastes recommended by E. E. Lafaye, commissioner of public property. The plan includes a Cobwell garbage-reduction plant, refuse sorting and utilization and the incineration of unutilizable wastes. The estimated cost of the reduction plant alone is $750,000, of which $598,000 is for equipment to be supplied by the Cobwell Corporation, Cleveland and New York, and the remainder for buildings and site. The entire project is to be financed by the Metropolitan Life Insurance Co., New York City, on the basis of certificates issued by the city, payable in 14 annual installments. Tentative contracts have been made with each of the two companies named.

TWO-HUNDRED-TON COBWELL PLANT

The reduction plant is to have a capacity of 200 tons a day. It will include 40 reducers, various accessory tanks and conveyors and a 15-hp. boiler plant with automatic stokers. The Cobwell Corporation claims that 60,000 tons of garbage treated annually in the proposed plant will yield 1800 tons of grease worth $252,000 and 10,800 tons of tankage worth $129,600, making a yearly revenue of $361,600 or $6.03 per ton of garbage. Against this it figures operating and capital charges of $4.10 a ton, or $246,000, leaving an estimated profit of $135,600. This would not be clear profit to the city since the tentative contracts provide that 40% of the net earnings in any quarter up to $12,000 and 5% on all above that amount shall be paid to the Cobwell Corporation as royalties.

ESTIMATE OF OPERATING COST

The detailed estimate of operating cost per ton of garbage is: Coal, maximum (based on 14,000 B.t.u.) $1.10; electric power and lighting (current purchased), $0.20; solvent loss maximum, 4½ gal., $0.40; labor (average 30c. per hr.), $1; miscellaneous supplies, material and labor, $0.30; depreciation at 3% and interest at 5% on $750,000, $1; administration, $0.10; total, $4.10. It will be noted that this estimate does not take into account the fact that the certificates for financing the project must be retired in equal annual payments extending through 14 years. The tentative contract provides that the grease left in the tankage shall not exceed 3%; also that if during the last 30 days of the initial four months' operation of the plant (under the supervision of the Cobwell Corporation) the estimates just given are not fulfilled the net deficiencies, after balancing under-performance and over-performance, are to be deducted from royalties. The detailed plans for the reduction works are to be prepared jointly by engineers and architects representing the city and the contractor, but the latter will have the say as to requirements dominated by its process. Barring war delays, the contractor agrees to have the reduction works ready for operation within a year of the date of the final contract.

Engineer Employment Agency Opened by Labor Department

The United States Department of Labor has recently opened at 845 South Wabash Ave., Chicago, Ill., a division known as the Teachers and Professional Service Division, whose function it will be to aid the employer in obtaining suitable help, and professional persons in securing suitable employment. While intended to embrace all professions, attention has thus far been confined to the teaching and engineering professions. The services of the division will be absolutely free to both employer and employee, all expenses being borne by the Government. The methods which will be pursued will be quite thorough and no service will be rendered an applicant until the division has learned, from persons familiar with the applicant's record, that he is qualified as to training, experience and personal qualities.

After an applicant is recommended for a reported vacancy, the employer is given an opportunity to examine the data and the way is prepared for a personal interview. The officers of the division will provide a place where the employer may meet his prospective employee.

State Need Not Repair State Road Through Borough

The County Court of Dauphin County, Pennsylvania, has ruled that there is nothing in the Highway Act of 1911 which requires the state to make repairs on a state highway which is at the same time a borough street. The decision was given in refusing a writ of mandamus asked by Gettysburg to compel the state to repair a borough street. The court also ruled that there is nothing which allows the State Highway Commissioners to interfere with a borough highway.

Newark Shipyard to Employ 12,000 Workers

The United States Shipping Board and the Submarine Boat Corporation, which is erecting the ship plant for the emergency fleet, are coöperating to spread among the steel and iron workers of the country the news of the great need for them in the task of turning out the standardized steel ships which will be constructed at this yard. It is understood that the Newark yards are to employ 12,000 men on their first contract for building 50 vessels of 5000 tons each. This preliminary contract, which was signed last month, will be followed in all probability by another for 150 vessels.

Railway Bridge and Building Men Convene

Discuss Bridge Erection, Coatings for Steel Camp Structures and Other Subjects

The erection and protection of steel bridges and the equipment of camps for bridge and construction gangs were among the subjects discussed at the annual convention of the American Railway Bridge and Building Association. This meeting was held in Chicago Oct. 16, 17 and 18, with a large attendance of engineers and superintendents of bridges.

The placing of new plate-girder spans with the minimum interruption to traffic was dealt with in a committee report presented by Lee Jutton, division engineer of the Chicago & North Western Ry. Two general methods are practicable: Piecemeal removal of the old and construction of the new spans, or the replacing of an entire span at one operation. Mentioned in the discussion that followed was the erection of concrete slab spans alongside the old work, with ballast and track complete. In this way the track could be connected up as soon as the new span had been moved into place.

PRESERVATIVE COATINGS

Paint for steel and other structures was covered in a report presented by Charles Ettinger, Illinois Central R.R. For steelwork, he considered that the primer or first coat should be a rust-inhibitive coating with lead base. Carbon paints may be applied over this, but should not be applied directly to the steel. The report pointed out the economy of using high-class paint for structures of this kind.

Concrete as a protective coating for steel structures was presented in a paper by E. E. R. Tratman, Western editor of *Engineering News-Record*.

The importance of good housing and feeding as a means of keeping men in the crews of the railway bridge and maintenance-of-way departments was the subject of a paper by F. E. Weise, chief clerk in the engineering department of the Chicago, Milwaukee & St. Paul Ry. There are many objections to the use of cars, which are generally old cars removed from their trucks and mounted on sills. Buildings of concrete or of stucco on wire mesh are used in a few cases. Some railways and construction companies are introducing portable sectional knock-down houses. Most of these are of wood, but sectional steel structures for similar purposes are available.

Another subject discussed in regard to labor was the introduction of differential rates of pay for employees; that is, paying higher rates to men having the greater skill or experience.

Officers for 1917-18 were elected as follows: President, S. C. Tanner, Baltimore & Ohio R.R., Baltimore; secretary, C. A. Lichty, Chicago & North Western Ry., Chicago. The next meeting is to be held at New York in 1918.

ENGINEERING SOCIETIES

The Providence Engineering Society was addressed on Tuesday evening, Oct. 16, by F. A. Barbour, supervising engineer of Camp Devens, on the subject of "The Construction of the Army Cantonment at Ayer." The lecture was illustrated and constituted the October meeting of the society. Other meetings scheduled for the near future are: Oct. 29, "The Fire Hazard of the Automobile," by A. P. Vigneron, of the Automobile Mutual Fire Insurance Co. of America; Nov. 15, "Notes on Municipal Engineering," an illustrated talk by Milton H. Bronsdon, city engineer, Providence, R. I.; Nov. 14, "Steel and Iron Pipe," by Harold T. Miller, of the National Tube Works; Nov. 9, "Handling and Moving Materials, Including Incoming and Outgoing Materials, Arrangement of Materials, Control of Materials, Shop Classification, Etc.," by Chester T. Morey, of the Rhode Island Tool Co.; Nov. 13, "Some Steels Used in Machine Construction, Their Composition, Physical Properties, Treatment and Metallography," by Chester B. Sadler, of the Rhode Island Tool Co.; Nov. 1, "The Engineering of a Telephone Plant," by John T. Frankenburg, superintendent of the Providence Telephone Company.

The Harvard Engineering Society of New York will hold its first regular meeting at the Harvard Club Wednesday evening, Oct. 31, at 8:30 o'clock. Prof. Douglas W. Johnson, of the Department of Physiography of Columbia University, will give an illustrated talk on the European War, showing the intimate relation between the movement of troops and the topography of the country.

PERSONAL NOTES

CLIFFORD OLDEN, bridge engineer of the highway division of the Illinois State Department of Public Works and Buildings, has been appointed acting chief highway engineer until the position made vacant by the death of William W. Marr is filled by regular appointment.

GERALD J. WAGNER, construction engineer for the Michigan Railway Co., has been appointed city engineer of Grand Rapids, Mich., vice W. S. Moore, who is now chief engineer of the highway department of Indiana.

O. L. DILLON, JR., formerly superintendent for the Canal Construction Co., Chicago, and the Hoosier Land and Investment Co., Sikeston, Mo., is now chief engineer and superintendent for the Johnston-Porter Clay Co., McKenzie, Tennessee.

H. H. ESSELSTYN has formed a partnership with L. F. MURPHY and R. G. HANFORD, and will engage in general engineering and architectural business. Mr. Esselstyn was for 15 years connected with the Westinghouse-Church-Kerr Co. in various positions. Mr. Murphy was previously associated with J. G. White & Co. and in other public-utility organizations, and Mr. Hanford has been associated with F. L. Packard, Columbus, Ohio, for the past six years.

H. C. DREHER, C. A. BARKER and F. R. PATTERSON have formed the Dreher Construction Co., general contractors, Chicago, and will carry on a general contracting business, specializing in reinforced-concrete construction.

MAJ. C. T. WARING, who was engaged in various capacities on the Panama Canal from 1905 till 1909, then becoming assistant engineer on the Cape Cod Canal, and later holding the position as resident engineer and superintendent on the same work, now has charge of the construction of six aviation schools in northern Texas.

D. D. CLARK, chief engineer of the Bureau of Water-Works, Portland, Ore., and builder of Portland's water system, has resigned on account of ill health, his resignation taking effect Oct. 1. Mr. Clark is recognized as an authority on hydraulic engineering and has been employed by the City of Portland since 1893, for the past 20 years being chief engineer of the Water Bureau. During Mr. Clark's tenure the slides which threatened the complete destruction of the two city reservoirs in 1903 and 1904 were stopped through the construction of a tunnel drainage system.

W. F. COLLAR, for the past two and one-half years in complete charge of construction of the east approach of the Municipal Free Bridge for the City of St. Louis, has resumed his connection with the Foundation Co., New York. His present position is that of assistant to the Western manager, F. W. ADGATE, with headquarters in Chicago.

ERNEST MCCULLOH, formerly with the city engineer's office of Los Angeles and who was for 10 years connected with the United States Reclamation Service on the design and construction of the Tieton and Sunnyside projects in Washington, is now associated with the Charles L. Pillsbury Co., engineers, Minneapolis and St. Paul, having charge of the recently organized department of civil engineering of that company.

MAJ. PHILIPPE BUNAU-VARILLA, at one time general manager of the old French Panama Canal Co., and who is now serving as major of engineers in the French Army, has been commended by General Petain for his services in the reorganization of French positions during the recent Verdun attack.

PROF. E. J. BABCOCK, dean of the College of Engineering, University of North Dakota, has been made acting president owing to the resignation of DR. FRANK L. MCVEY, who has accepted the position of president of the University of Kentucky.

A. L. LUEDKE has recently been promoted to be assistant to the Director of the United States Office of Public Roads and Rural Engineering, with headquarters at Washington.

MANUEL L. VICENTE has been appointed professor of civil engineering, University of Porto Rico. Professor Vicente has been connected with the civil engineering department of this university for the last three years, his most important work having been the remodeling of the courses of study in civil engineering to agree with those given in American universities.

HOMER HAMLIN, formerly city engineer of Los Angeles, Calif., has opened an office as consulting engineer and geologist in the Central Building, Los Angeles, Calif. Mr. Hamlin will specialize in surface and underground water-supply, sewerage, sewage-disposal, irrigation, land drainage and municipal and civil-engineering problems.

SOL PINCUS, assistant sanitary engineer, United States Public Health Service, has been assigned to duty in connection with the sanitary engineering problems of the new army camps. He is now engaged in the extra-cantonment zone of Camp McClellan.

R. H. THOMSON, consulting engineer, Seattle, has been engaged to investigate and make a report to the Spokane County Commissioners on the alleged failure of certain permanent highways in Spokane County, Washington.

MAJ. WILLIAM D. WRIGHTSON, formerly with the United States Public Health Service, is at present in charge of the Sanitary Corps, National Army.

F. R. GOODMAN, formerly state division engineer, is now engineer of Coconino County, Arizona, with headquarters at Flagstaff.

OBITUARY

GEORGE W. WESLEY, an engineer in the employ of the Lackawanna R.R., died at his home in East Orange, N. J., Sept. 27.

HARRY M. GOULD, president of the Gould Contracting Co., Nashville, Tenn., died Sept. 30. A graduate of Rensselaer Polytechnic Institute, for a year or two he was connected with the engineering department of the Louisville & Nashville R.R., then becoming associated with his father, JOHN E. GOULD, in the Gould Construction Co., Louisville, Ky. In 1907, when this company was merged with Foster & Creighton to form the Foster, Creighton, Gould Co., Mr. Gould was made vice president and general manager, and as such erected the Sparkman St. and Jefferson St. bridges over the Cum-

berland River at Nashville, and the substructure of the Kentucky & Indiana Terminal Railroad Co. bridge over the Ohio at Louisville, Ky.; the superstructure of the Fort Smith and Van Buren St. bridge over the Arkansas River at Fort Smith, Ark., and many other steel structures for the Louisville & Nashville R.R. In 1915 he formed the Gould Contracting Co., which has much railroad bridge work and hydro-electrical development work under way.

BUSINESS NEWS

Federal Export Corporation Buys New Mexico Central Railroad

The New Mexico Central R.R. has been purchased by the Federal Export Corporation, of 115 Broadway, New York. This property lies in a section of New Mexico that has recently been opened to oil developments. The line has a length of 120 miles, extending from the City of Santa Fé, where it joins the main line of the Atchison, Topeka & Santa Fé R.R., south and southeast to Willard, where it crosses the southern branch of the Santa Fé road, and thence to Torrance, where it connects with the El Paso & Southwestern.

The Federal Export Corporation has in project the electrification of the road or its reëquipment with internal-combustion locomotives. Its engineers are at present examining the property with the object of ascertaining the most available means of placing the road on a more productive basis.

American Machinery Needed in Scotland After the War

United State Consul Rufus Fleming, at Edinburgh, Scotland, reports:

"Notwithstanding taxation will rest heavily upon every community in consequence of war expenditures, soon after the return of peace large projects must be undertaken in this part of Scotland.

"Streets and highways have been badly worn by increased traffic and repairs have been deferred; harbor construction and improvements, for which full arrangements were made several years ago, are in abeyance owing to financial and labor problems; and tramway extensions, important housing schemes, sewerage works, industrial plants, land clearing and drainage enterprises, and the development of mines and quarries are among the other works, public and private, which must receive attention when conditions will permit.

"American manufacturers and exporters of machines for engineers and contractors in the various lines indicated could probably cover this market in the most satisfactory way from general agencies in English commercial and industrial centers to which the engineering and building concerns throughout the country are in the habit of sending orders for heavy machines of all kinds."

Westinghouse Electric Company Announces Wage Increase

Another increase in wages for shop employees aggregating nearly $2,000,000 a year has just been announced by the Westinghouse Electric and Manufacturing Co. Effective Oct. 16, all employees observing shop hours, except munition workers, receive an additional bonus of 10% if they are on a salary or time-rate basis, and of 7% if they are on a piece, premium or task basis.

The 20,000 shop employees of the Westinghouse company form one of the most highly skilled organizations in the country. They are one of the best-paid bodies as well, increases granted since the outbreak of the European War now amounting to about 60% of the former average compensation.

Notes from

MAKERS OF PLANT AND EQUIPMENT

Page Woven Wire Fence Co. announces the change of its corporate name to Page Steel and Wire Co. A Pittsburgh office at 644 Union Arcade was opened Oct. 22 with E. C. Sattley as general manager.

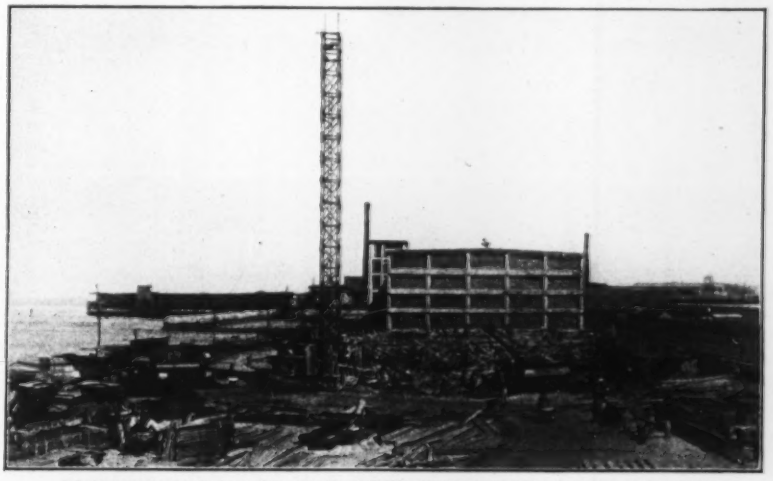
American Pulverizer Co. has moved its general and sales offices, factory and new experimental laboratory to 18th and Austin Sts., St. Louis, Mo.

Charles C. Cheyney, manager of the Chicago office and store of the Buffalo Forge Co., has a commission in the Naval Aeronautic Corps and is beach engineer at Pensacola, Fla., in charge of airplane engines.

C. F. Goodrich, assistant manager of the Buffalo Forge Co.'s Boston office, has left for active duty as first lieutenant in the Ordnance Department, and is stationed at the Watervliet Arsenal.

Don R. Marsh, production manager with the Buffalo Forge Co., has given up his work to assume similar duties at Washington in the production of ammunition. Mr. Marsh will receive a captain's commission.

Plymouth Cordage Co., North Plymouth, Mass., is putting up new buildings with capacity sufficient for the storage of 200,000 bales of fiber and 50,000,000 lb. of rope and twine. The warehouse shown in the accompanying illustration is 100 ft. wide, 302 ft. long and seven stories high. A second warehouse now under construction is 82 ft. wide, 202 ft. long and three stories high. The uncertainty of the transportation situation, the Plymouth company has found, has made it absolutely necessary to carry in stock at all times sufficient fiber to keep the mills running for long periods, while the hundreds of sizes and kinds of rope manufactured make necessary large stocks for immediate shipment upon a distributors' order.



PLYMOUTH CORDAGE CO.'S NEW WAREHOUSE CONSTRUCTION

R. M. Elder, branch manager at Des Moines, Iowa, for John Baker, Jr., asphalt and bituminous products, is now manager of the railroad division of the same firm, with headquarters at Chicago. Mr. Elder was formerly superintendent of construction on fortifications of the Panama Canal.

H. F. Bardwell has been appointed New York district manager for the Vanadium-Alloys Steel Co., of Pittsburgh and Latrobe, Penn., with offices at 30 Church St., New York.

TRADE PUBLICATIONS

"A Quarter Century of Success" is the title of a new catalog of the Neptune Meter Co., 50 E. 42nd St., New York, which deals with the development of the Trident water meters.

The Ball Engine Co., Erie, Penn., is distributing a new bulletin containing

specifications of Type B steam shovel, also special features of design and details of construction which ought to be of use to those interested.

The Sullivan Machinery Co., 122 South Michigan Ave., Chicago, Ill., is distributing Bulletin 75C describing angle-compound power-driven air compressors and Bulletin W75F on Tandem Compound Corliss Air Compressors.

Journal-box packings are described in a new pamphlet of the Franklin Manufacturing Co., Franklin, Penn., which is said to be the first write-up on the subject and should be of value to those having to do with railway journal lubrication.

The Dean control system, for use with steam, water and gas valves is described in a leaflet issued by the Cutler-Hammer Mfg. Co. A feature of the apparatus is that motor, gearing, limit switch, clutch and lost motion device are incorporated in one casing attached to the valve yoke, instead of being separate.

Taylor Instrument Co., Rochester, N. Y., has just issued a catalog on temperature regulators.

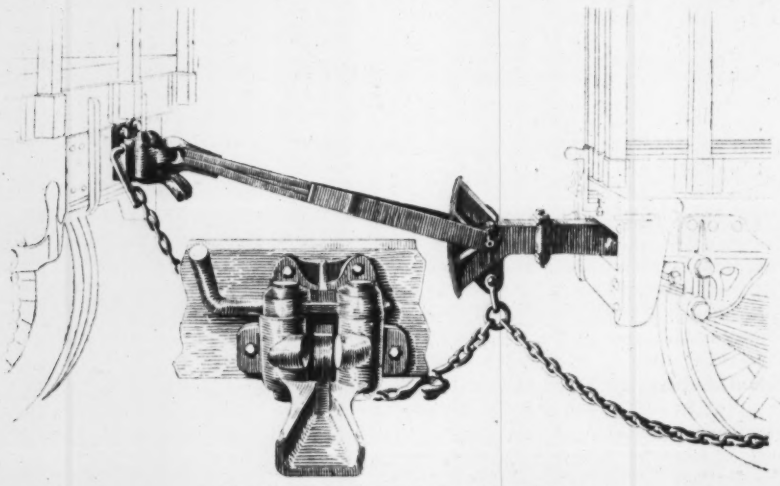
The Steelite Co., Guardian Building, Cleveland, Ohio, has issued a new loose-leaf catalog containing colored reproductions of standard designs of Steelite elevator cabs and inclosures.

APPLIANCES AND MATERIALS

Automatic Truck-Trailer Hitch

To connect trucks and trailers, the Troy Wagon Works Co., of Troy, Ohio, is placing upon the market the automatic truck hitch illustrated herewith. The main casting is of malleable iron and the two jaws of steel. In making a connection all the operator has to do is to raise the hand lever and part the jaws, then steer the connecting bar into the apron of the hitch, which will guide it into the jaws and trip the lock, so that the coupling is made like that of the ordinary railroad car. This arrangement permits the coupling to be made without the operator going between the truck and trailer, for he can stand to the side and guide the connecting bar into the apron of the hitch by means of a stick, and from any angle, thereby avoiding the possibility of accident.

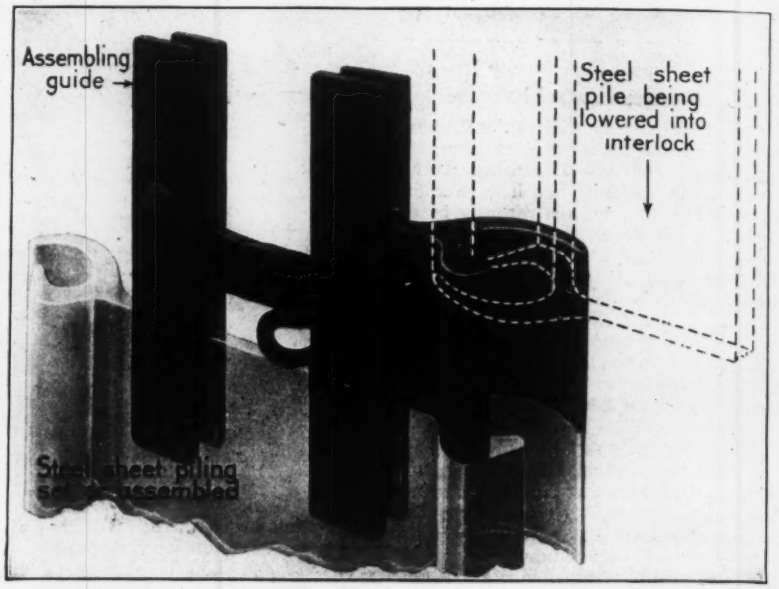
When the coupling is made, as the jaws close in front they open in the rear, which allows the hand lever to drop and throw a lug between them, so there is no possible way for the jaws to open and release the connecting bar until the hand lever is raised by the operator. To uncouple, the operator simply raises the lever and the truck pulls away. One change has been made in the hitch as shown by the illustration. Instead of having to drill the truck frame, the Troy company made the large casting longer and bored three holes at the bottom so that the bolts straddle the frame. This makes the hitch adjustable to any width frame and can be changed from one truck to another very quickly.



AS SAFE AS A M. C. B. COUPLER

Special Device Helps in Handling Lackawanna Sheet Piling

On windy days or when the handling line is swung from a barge affected by swells or wave motion, the sway of the steel sheet-piling sections has made trouble in steering the interlock of the free piling sections into entrance and sliding contact with the interlock of the last piling section placed. This is particularly true where the tops of those piling sections, which have been assembled or placed, remain at a considerable distance from the ground or water level.



GUIDE IS SECTION OF PILING WITH PART OF THUMB OF INTERLOCK CUT AWAY

To save time and labor and make the attendant's work safer in this operation, the assembling guide shown in the illustration was developed by F. E. Cudworth and successfully used in placing the 50- to 70-ft. Lackawanna sheet-piling sections used in the 46th St. pier cofferdam, New York City. The construction of this special guide is shown very clearly in the illustration. It is reversible to handle either position of interlock, and is provided with a swivel eye and safety line that prevents the guide from falling out of reach or getting lost in the water.

In using this device the workman draws the free piling section sidewise into and against the guide as the piling section descends, and as the interlocks are in this way aligned perfectly, they slide together on the first trial. On the work above mentioned it was found that an operator skilled in handling a lighter could easily lower a sheet-piling section within the range of the guide, and that the guide then enabled the section to be placed with a minimum of labor.